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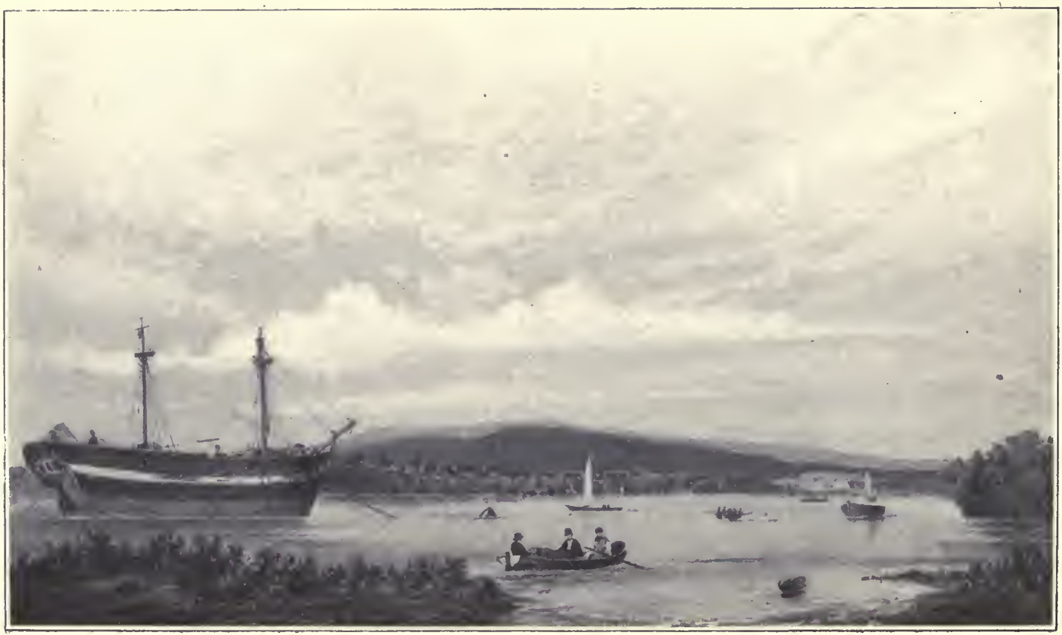

Port Adelaide in 1838.

THE

Geography of South Australia

HISTORICAL, PHYSICAL, POLITICAL & COMMERCIAL

BY

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Lecturer in Geology and Palæontology, Adelaide University;
Fellow of the Geological Society of London, 1878;
Clarke Memorial Medallist 1907;
Ferdinand von Mueller Memorial Medallist, 1913.

WITH AN INTRODUCTION BY

PROFESSOR J. W. GREGORY, D.Sc., F.R.S.

REVISED EDITION

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PREFACE TO THE FIRST EDITION.

The need of a book dealing with the geographical features of South Australia on broad lines has long been felt. It is hoped that the present work will in some measure supply such a desideratum.

The aim of the writer has been to condense into a convenient form such information as may be found useful, not only to those engaged in teaching the subject, but also to a wider circle of general readers. Brevity has been observed throughout, but the principles involved have been brought into prominence, and these can be easily applied by the teacher in amplifying the subject according to local circumstances.

In a school book it is sometimes difficult to present a subject clearly and intelligently without creating an overburden of details. Knowledge, to be useful, must include a certain amount of detail, but no more detail has been admitted than was felt necessary for the lucid presentation and exposition of the facts.

The physical features of a country are determining factors in its history and possibilities. A large proportion of the work is devoted to this aspect of the subject, and it is hoped will be found of assistance to the teacher in the interpretation of the topographical features of his neighbourhood. A river, cape, or mountain, means something more than a mere geographical expression. Each has a history and a destiny, and in the "Nature Study" of the present day it is necessary to find a reason for their existence and form. In this section of the book not only are the salient physical features of the country noted and described, but the "Reason Why" has been given. Much new matter, based on original observations, has been included. The attention of teachers is particularly called to our river systems and their geological history. Earth movements have occurred in South Australia of recent geological date that have produced modifications of surface features of great interest. Old river systems have been dismembered, or drained by the creation of new outlets, while others have undergone elevation and obtained a rejuvenescence of energy. Many localities, if looked for, will afford useful field lessons, in this way.

In the description of certain topographical features it has been necessary to point out their geological significance. This has been done with as little use of scientific terms as possible.

and the Table of Strata, given in the Appendix, will make intelligible any references to the geological order of succession that may occur.

The physical geography of South Australia would not have been complete without some reference to its Natural History. The chapters dealing with the Flora and Fauna, while scarcely adapted for class work, might form the basis of object lessons on such subjects as, the wild-flowers of our hills, the limitations of certain plants and trees to particular soils and altitudes, and the peculiar position which Australia occupies in its archaic forms of life, to other zoological provinces.

Considerable attention has been devoted to those aspects of the subject which illustrate the evolution and consolidation of the State. Every South Australian child should know something of the land in which he lives—the circumstances of its foundation, the heroic work done by its explorers, the growth of its industries, and the principles of its Government.

The bibliographical references at the end of chapters, or scattered through the text, whilst limited in extent, may be found of service in guiding to further information.

I am placed under great obligation to Professor J. W. Gregory, D.Sc., F.R.S., for his lucid and interesting "Introduction," which has greatly enhanced the value of the work. I am also indebted to the heads of the Government Departments and other members of the Civil Service, who have courteously and readily supplied information from official sources. Of these I ought especially to single out for acknowledgment Mr. Thomas Gill, I.S.O., the Under-Treasurer, and Mr. J. W. Jones, J.P., the Secretary of Public Works, who have invariably shown a keen interest in all matters of scientific research, and have been ever ready to give the helping hand to the explorer and investigator.

For the illustrations contained in the work I am under obligations to the Government Lithographer (Mr. Vaughan), Crown Lands Department; the Commissioner of Railways, Professor J. W. Gregory, and others whose names will be found attached to the illustrations concerned. My thanks are also due to Mr. R. J. M. Clucas, Librarian, Adelaide University, for kindly assisting in reading and correcting the proof-sheets.

WALTER HOWCHIN.

Adelaide, September, 1909.

PREFACE TO THE SECOND EDITION.

The first edition of this work having become exhausted, a new edition has been called for. The work remains substantially as at first issued but certain corrections, alterations, and additions have been made, chiefly in bringing the book up to date. Important changes have occurred in South Australian conditions since the earlier edition was published, and these have received attention in the present issue. The Northern Territory was taken over by the Commonwealth Government in 1911, and as this portion of the continent no longer forms a part of South Australia it has been thought expedient to exclude the sections that dealt with Northern Territory matters.

The railways of the country have been greatly extended in the interval, including the great western line between Port Augusta and Kalgoorlie, carried out by the Commonwealth Government, and by its means direct railway connection between all the capitals of the mainland has been established.

The record drought of 1913-1914, together with the calamitous war that is still in progress, have formed powerfully disturbing factors in the trade of the community, and, in consequence, the statistics of the last few years do not present a fair view of the prosperity of the State. The two seasons that have succeeded the great drought have been the most productive in cereal returns that the country has ever known, and yet, through want of shipping facilities, the State has failed to realise the full benefits of its record harvests.

The introduction of compulsory service for Home Defence, is another of the more important lines of departure in recent years, and the enrolment and equipment of a volunteer army in defence of the Empire, while causing a heavy strain on the Commonwealth, has created a national sentiment of great value, and a stronger emphasis of those high ideals which make a people virile and worthy.

October, 1917. W.H.

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The Geography of South Australia

INTRODUCTION.

By J. W. Gregory, D.Sc., F.R.S.

I.—The Route to the Interior.

The railway journey from Adelaide to Murray Bridge affords an excellent introduction to the geography of South Australia. While the train slowly climbs the steep scarp of the Mount Lofty Range, there is gradually unrolled a panoramic view of the coastal plains; while it crosses the undulating surface of the plateau, there are glimpses to be caught down timbered glades; and finally as it descends the easternmost slopes of the hills, it commands wide-ranging views across the vast basin of the Murray.

The country in this part of the State is thus seen to consist of a range of highlands, formed of a plateau with an undulating surface, a steep western face and gradual eastern slope. At the eastern foot of this range of highlands lie the wide spread plains of the Murray, which continue still further eastward toward the Victorian border, originally called the Ninety Mile Desert, but is now a great wheat-producing district. At the western foot of the plateau is a narrow strip of coastal-plain, which sinks into that great forked arm of the sea, Spencer and St. Vincent Gulfs. The country, reduced to its simplest expression, therefore consists of a belt of highlands, separating two broad low-lying basins. The western basin is still occupied by the sea; but from the eastern basin the sea has been ousted by deposits laid down by the Murray; and that river now meanders across a level plain to its end in the great lagoon of Lake Alexandrina, whence its waters escape over shallow sand-bars into the Southern Ocean.

The western side of Spencer Gulf is formed by the edge of another plateau, which extends westward into Western Australia. Adelaide stands, therefore, on the boundary line between eastern and western Australia, and the division is here formed by an arm of the sea, which runs for two hundred miles into the interior of the continent.

The existence of this great valley has had a powerful influence on the historical and political development of the State of South Australia.

Adelaide was founded in 1837, and its enterprising settlers at once began the exploration of the highlands that rose behind their narrow strip of coastal plain. Morphett and three companions explored Mount Lofty in 1837, and the three Overlanders, Hawdon, Bonney, and Eyre, traversed the belt of highlands in their journey to Adelaide, from what was then known as Port Phillip Settlement. The reports of these explorers regarding the land behind Adelaide was disappointing; the climate was hot, the soil arid, and there was none of the turf-clad plains of western Victoria that were then being " taken up " as great sheep stations. Men accordingly turned their attention towards the interior, trusting to find a higher country with a cooler climate and ampler rainfall.

Spencer Gulf was known to extend for two hundred miles northward, for Flinders had sailed up it, in 1802, to its northern limits. Spencer Gulf and the valley at its head promised an easy road into the interior. The Gulf offered water carriage for two hundred miles northward. Accordingly, in May 1839, E. J. Eyre started from the head of the Gulf to search for the land of promise which it was believed must exist in Central Australia. In his first journey he passed Mount Arden, the furthest point hitherto seen by white men, and continued northwards to a hill, subsequently named Mount Eyre. In an expedition, made in 1840, he was able to penetrate much further into the interior; he crossed the hills to the north-east of Lake Torrens, and entered the still greater basin of Lake Eyre.

The results of these and all the early journeys were economically disappointing. Eyre and his successors found that this promising route to the interior was a delusion; the expected valley was there; its grade was easy; its floor was open; but instead of fertile plains they traversed deserts, and instead of a great river worthy of the vast area it was supposed to drain, the only water lay in pools of brine, a few brackish springs, and the useless salt swamps on the salt-encrusted floors of former lakes. The most northern hills, which Eyre reached, he named Mount

Deception and Mount Hopeless; and, as he had found lake-beds, which he thought belonged to one continuous lake, to the west, north, and east, he concluded that the hilly country to the east of Lake Torrens was a peninsula, projecting northwards from the highlands behind Adelaide, and protected by an impassable natural moat on all sides except on the south. "On every side," said Eyre, "we were hemmed in by a barrier, which we could never hope to pass."

In spite of Eyre's disappointment, in spite of the more graphic stories of hardship and suffering with which Sturt returned from his attempt to get round the eastern side of the supposed horseshoe lake, in spite of the chagrin and bitterness which came from the early attempts to reach the centre of Australia by a route to the west of Lake Torrens, Adelaide still looked to the north as its natural "hinterland." The existence of Spencer Gulf and its northward continuation has rendered it geographically inevitable that the development of Central Australia should have been largely conducted by the citizens of Adelaide. They, undaunted by failure and undeterred by ill report, persevered in their search for a Land of the Golden Fleece, until even Sturt's Stony Desert was occupied by cattle stations, the camp where he was imprisoned by drought was the centre of a gold-field, and weekly mail coaches ran across the land where Burke and Wills perished in misery and despair. A railway now stretches into the interior 688 miles north of Adelaide, and a telegraph line and its chain of stations is continued right across the continent to the northern coast.

But in 1911 the Northern Territory was taken over by the Federal Government and is now under Federal control.

II.—SOUTH AUSTRALIA THE SOUTH-CENTRAL STATE.

The name South Australia has been considered by some to be somewhat inappropriate, and Laurie suggested that it should be altered to Centralia. The name South Australia, though once correct, is now certainly misleading. The State is no longer the southern state of Australia, for it does not reach as far south as Victoria. The change of name might save the Post Office the trouble given by English correspondents, who conclude, from geographical probabilities, that Melbourne must be the capital of South Australia. Such a change is not, however, to be recommended; for the present name is a permanent memorial of the fact that the colony was founded when Victoria was a despised and neglected part of New South Wales; and it reminds us that ages ago the country extended southward into the Southern Ocean far beyond its present limits.

The name Centralia would, certainly, be appropriate as descriptive geography; for though the State has a long coast line (which is fully described by Mr. Howchin on pp. 63-76) and is deeply indented by the long rift valley of Spencer Gulf, the Southern Ocean has but a comparatively slight influence on the geography of the State. Its northern districts are typical representatives of the arid plains of Central Australia, and owing to an unusual combination of geographical conditions these inland characters extend quite to the sea shore in some districts, and elsewhere only a narrow belt benefits materially from the adjacent sea. South Australia is an area which, considering its vast extent of 380,070 square miles is of unusual uniformity alike of topography, economic resources, structure, and history. It has the uniform surface of an ancient country with a scanty rainfall; and as its agricultural and pastoral products are incomparably the most valuable, there has been none of the difficult competition between conflicting industries or areas, that has harassed many states with more varied conditions.

The extent of the economic supremacy of the agricultural and pastoral interests of South Australia is shown by Fig. 1, which represents the relative value of the products obtained by manufactures, by mining, and by farming, in each of the five states on the mainland of Australia.

III.—Its Continental Climate.

Though the Southern Ocean washes the shores of South Australia for 1540 miles of coast, yet it has remarkably small influence on the country geographically. In Victoria, in New South Wales, in Queensland there are coastal mountains which separate the typically continental inland plains from the typically coastal and sub-oceanic plains. In South Australia the coastal mountains have disappeared and with them have gone the usual climatic influence of an adjacent ocean.

South Australia has throughout the most typically continental of Australian climates. Thus its variations of temperature between summer and winter are more extreme; for, comparing the capitals, which are all on or near the coasts, the difference between the mean temperature for January and July is—

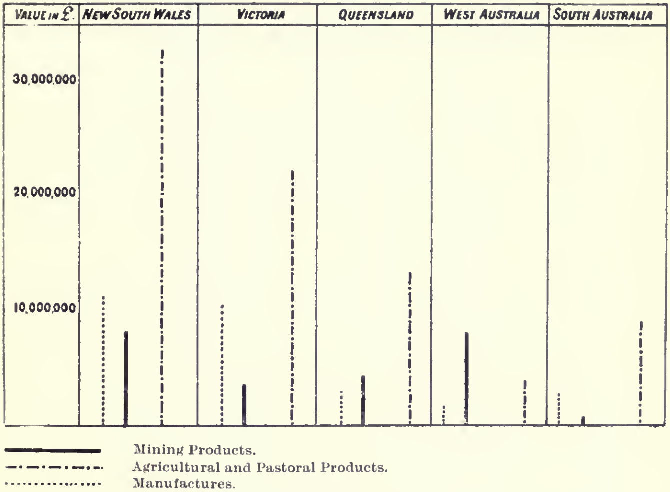

Fig. 1. Values of Products of the Manufacturing, Mining, and Agricultural (including Pastoral) Industries of the States for the year 1906.

Adelaide, 22½°.	Melbourne, 18½°.
Sydney, 19°.	Perth, 18½°.

Another continental character is that the annual rainfall shows less extreme variations; the line showing the annual rainfall of Sydney from 1840 shows much greater variations than that of Adelaide (Fig. 2), which keeps much closer to the average.

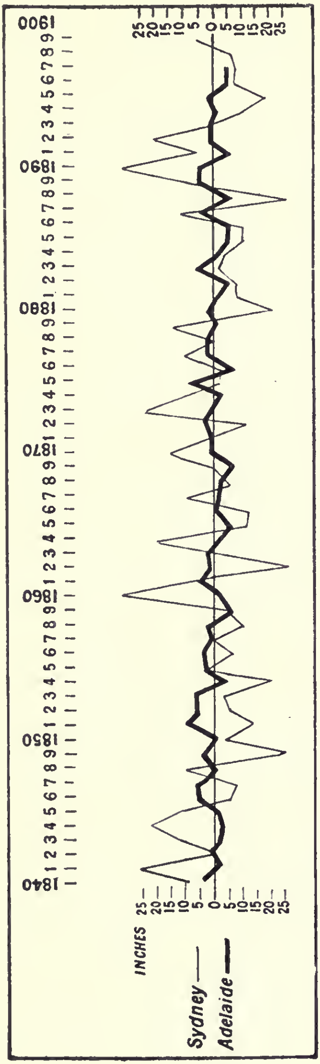

Fig. 2. The rainfall at Sydney and Adelaide. The rainfall at Adelaide undergoes less extreme variations than at Sydney; and a wet year at Sydney is often a dry year at Adelaide, and *vice versa*.

Similarly the rainfall is more uniform in distribution over the whole of South Australia than it is over each of the other states (Fig. 3); the difference is most extreme in Queensland, since that State is most under oceanic control.

Moreover, the amount of the rainfall in South Australia is far less than in the other States. Thus Figure 4 shows the relative areas of the States on the mainland which have a rainfall of less than ten inches, and the areas with more than ten inches. All Victoria has more than ten inches, and it is in South Australia alone that the arid regions (those with less than ten inches of rain per annum) occupy more than half the State.

IV.—Former Extension Southward.

The low rainfall of South Australia is chiefly due to the absence of coastal mountains. But South Australia was not always devoid of a typical coastal region. There is convincing evidence that the country once extended much further to the south. Kangaroo Island, with its long axis trending from east to west, the opposite projection of Cape Jervis Peninsula, and the westward trend of the end of the Yorke Peninsula that suddenly projects from it like a foot from a leg are all the remains of mountain ranges that once extended from east to west. The mountain ranges were members of a mountain chain that must have once formed a wide belt of lofty coastal mountains; they uplifted the moist air that flowed in from the Southern Ocean, by wedging it upward along their slopes, and collected from it abundant rains; and there are various traces in South Australia of the drainage which flowed down these mountains from south to north. But the loss of this former southern extension of South Australia over the Great Aus-

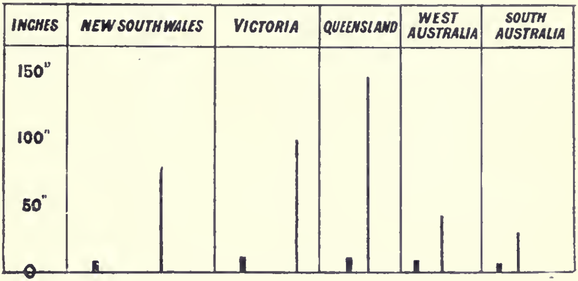

Diagram showing the average maximum and minimum rainfalls for the driest and wettest localities in each of the States.

tralian Bight, and south of Kangaroo Island has fundamentally changed the geographical conditions of South Australia.

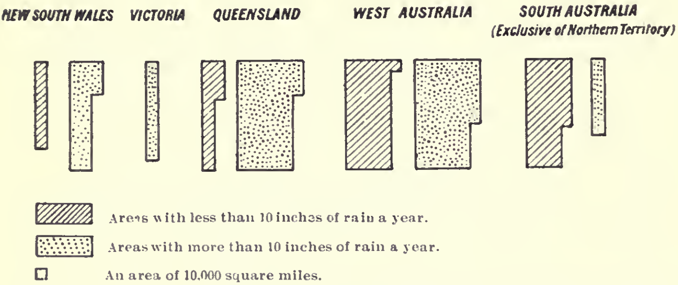

Fig. 4. Diagram shewing the relative areas in each State having rainfalls of more and less than 10 inches.

V.—Contrast Between the Coasts of South Australia and New South Wales.

How this valuable southern territory was lost and the consequences of its disappearance may be appreciated by contrasting the coasts of South Australia and of New South Wales. The two coastal types afford a striking contrast. In New South Wales the general course of the coast is from the east of north to the west of south, and it is fairly straight. When examined in detail, however, it is found to be deeply indented, for many great gulfs run far inland. The most famous Sydney Harbour, owes much of its beauty to the fact that it is a drowned valley; for as the land sank, the sea ran in branches and coves up the side valleys, while ridges were left projecting as varied peninsulas, and hill tops were converted into scattered islets.

The general uniform trend of the New South Wales coast is due to the fact that it runs parallel to the scarp of the East Australian Highlands, which rise at a comparatively short distance inland. The origin of this mountain scarp has been clearly shown in the neighbourhood of Sydney by Professor David. The cliffs at Sydney Heads on either side of the entrance to the harbour, are composed of sandstones that belong to the same series as occurs on the plateau of the Blue Mountains 3300 feet high, sixty miles inland. The occurrence of the sandstone at these two different levels is due to a great down-fold (Fig. 5, sect. 1), by which the rocks to the east have been lowered 3000 feet; and either a parallel fold, or a still sharper movement along a great fracture, has lowered the rocks still further to the east and formed the deep basin of the Tasman Sea off the coast of New South Wales.

South Australia owes its most conspicuous topographical features to earth movements that probably happened at the same time as those which formed the eastern coast of New South Wales; the frequent earthquakes in South Australia along the line of these movements (described by Mr. Howchin in pp. 135-141) and the "desert noise" heard rising from beneath the ground indicate that earth movements are still in progress. The Great Valley of South Australia, of which the southern end is occupied by Spencer Gulf and the northern by the basin of Lake Torrens, has been formed by the sinking of a long band of country between two great fractures (Fig. 5, sect. II.) that trend, like the coast of New South Wales, from the east of north to the west of south. If, as in New South Wales, the displacement of the rocks along these two fractures had been in the same direction in both, then the western fracture would have dropped all the south-western part of South Australia deep below sea level. Eyre Peninsula and the land to the north of the Australian Bight would

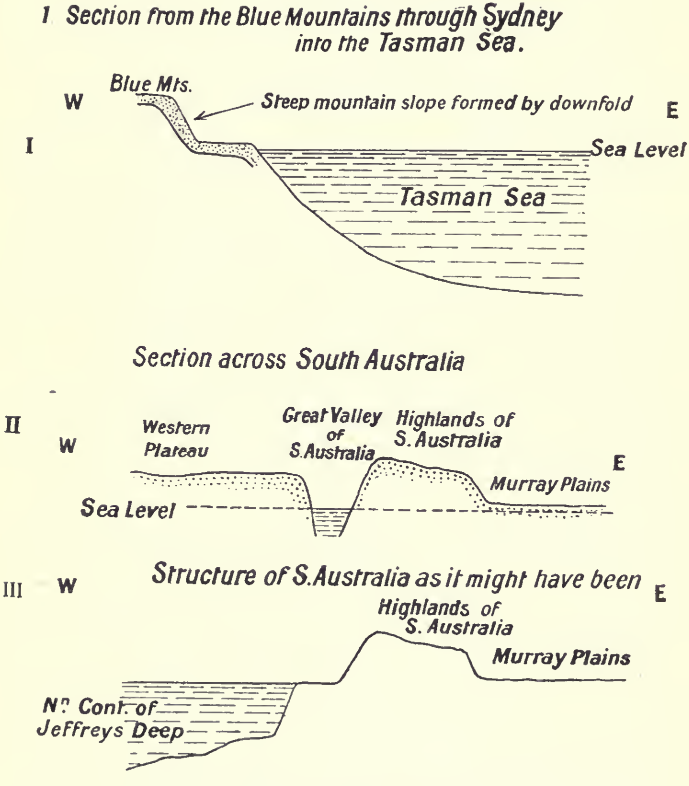
1 Section from the Blue Mountains through Sydney into the Tasman Sea.
I
W
Blue Mts.
Steep mountain slope formed by downfold
E
Sea Level
Tasman Sea
Section across South Australia
II
W
Western Plateau
Great Valley of S. Australia
Highlands of S. Australia
E
Murray Plains
Sea Level
III
W
Structure of S. Australia as it might have been
E
Highlands of S. Australia
Murray Plains
N? Cont. of Jeffreys Deep

Fig. 5. Diagrammatic Sections contrasting the structures of South Australia and the New South Wales coastal country.

Section I. The structure of Eastern New South Wales due to a double downfold.
Section II. The structure of South Australia and its rift valley.
Section III. The structure of South Australia as it would have been had the earth movement formed steps as in New South Wales, instead of a trough.

have foundered beneath the sea and become part of the enlarged Jeffrey's Deep off South Australia (Fig. 5, sect. III.). South Australia would have had a long coast line extending northward along the western foot of its Highlands, and it would have corresponded in geographical structure with the eastern coast of New South Wales; and facing the ocean instead of a gulf, it would, like the coastal districts of New South Wales and Western Australia, have had a better rainfall than it now enjoys. But the movements on the two fractures, which have made the great north and south valley of South Australia, produced a trough and not two steps. Instead of a coastal plain between a highland plateau and a deep sea, as in New South Wales, there is a rift valley between two plateaus, and the two mountain lines of South Australia strike the main coast nearly at right angles and not parallel to it.

The South Australian coast is, therefore, of the kind known as the Atlantic type, whereas that of New South Wales is an example of the Pacific type.

The South Australian coast, moreover, is much older than that of New South Wales. There are no representatives of marine rocks belonging to the recent periods in the earth's history anywhere on the New South Wales coast, though along its indented shores there are plenty of sheltered basins wherein such deposits would have been safely preserved had they ever existed.* The South Australian coast lands, on the other hand, are often covered by wide sheets of limestones, rich in shells, corals and sea urchins of kinds which show that the rocks are of no great geological antiquity. The ancient east and west mountains of South Australia had been broken up long before the formation of these limestones; and the occupation by the sea of the Great Australian Bight and its former extension northward beyond Eucla over the Nullarbor plains and up the Murray valley occurred long before the sea had reached the shores of New South Wales.

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* Occasional beach deposits, as at Shea's Creek, may be cited to the contrary; but they belong to a very recent period.

The well-known volcanic hills of the south-eastern district of South Australia were indirectly caused by earth movements of the same date as those which left the upstanding highlands; and later local movements gave the extinct volcano, Mount Gambier, its most famous features in the sunken basins that cluster at its base. The foundering of the land to the south of South Australia doubtless caused the eruptions that built up the volcanic hills; but, as Mr. Howchin remarks in his description of the volcanic action of that district, the Blue Lake and other depressions of Mount Gambier, are not true craters, but subsidences of the crust around the volcano as the result of a want of support.

VI.—The Geographical Plan of South Australia.

Kangaroo Island and the foot of the Yorke Peninsula are not the only traces of the ancient east and west mountains of South Australia. As shown by Fig. 6, the geographical plan of the State, there are other important remnants of the ancient mountain system. Extending east and west across the State near Port Augusta, are the Gawler Ranges to the south of Lake Gairdner. Further north are the

Musgrave Ranges, and across the frontier of the Northern Territory is the MacDonnell Chain. These east and west mountains have been in the main destroyed, partly by the wear and tear of the wind and rain and former streams, but largely by the result of earth movements. The former continuations of these northern lines are not at present buried beneath the sea like those to the south and west of Kangaroo Island; yet both the Musgrave and MacDonnell Chains have been cut off to the east by the great basin of Lake Eyre, which still sinks at its southern end below sea level, and was formerly occupied by a great sea that extended northward from the neighbourhood of Hergott Springs to the Gulf of Carpentaria.

The ancient east-to-west mountain chains are, however, to-day comparatively inconspicuous; the most striking geographical features of South Australia run from north to south and they are due to recent earth movements. These movements lowered a long band of country beneath the level of the land on either side. They formed a rift valley, the Great Valley of South Australia, separating two plateaus, the Highlands of South Australia to the east and the great Western Plateau of Australia to the west. The South Australian Highlands are the best known and most conspicuous mountains in the State, and they rise in Mount Remarkable near Port Augusta to the height of 3178 feet. This mountain is not, however, the highest summit in South Australia, though it rises the highest above the surrounding country; for Mount Woodroffe on the western Plateau in the Musgrave Range reaches the height of 5200 feet above the sea.

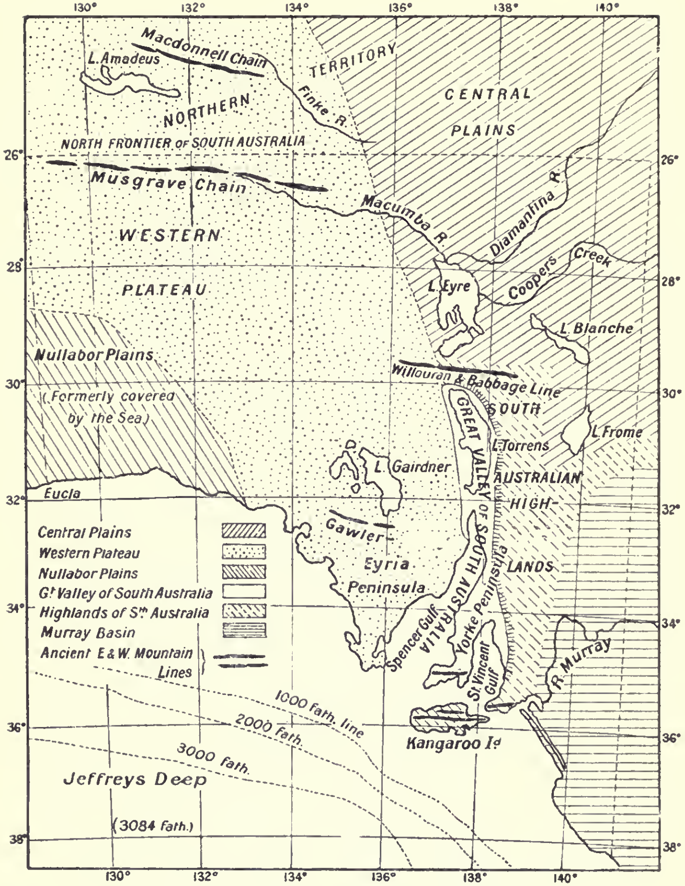

Fig. 6. The Geographical Plan of South Australia.

VII.—Effect of Coldness of the Southern Ocean.

The physical geography of a country is concerned not only with its essential structure, but with the moulding and weathering of the surface, which determines the shape and arrangement of its land forms, and the composition and value of its soils.

The essential and most striking characteristics of South Australia are due to its arid climate, so that the action of water is less important than in most countries. The comparative poverty of South Australia in water is due not only to the loss of the southern mountains that once collected moisture from the southern winds and nourished important rivers; it is also due to the coldness of the sea which washes the southern coasts. The south winds which sweep across South Australia bring in air containing much moisture from the Southern Ocean; but when this air reaches the land it becomes warmer, for the seas to the south are chilled by the drift of cold water from the far south. The land on the other hand is warmed by the bright Australian sunshine and draughts of hot air from the north. When air is warmed its power of holding moisture is increased. Air, therefore, blown ashore on to South Australia from the south is generally warmed, and thus instead of dropping its moisture as rain, it can carry more. It thus sweeps across the country as a drying wind, taking and not giving moisture. Therefore, in Victoria and New South Wales (see Fig. 7, I. and II.) a heavy rainfall is marked near the coast, and it rapidly decreases inland; but in South Australia a line that shows the decrease of rainfall has a very slight slope (Fig. 7, III.).

Owing to the scanty rainfall, South Australia is deplorably deficient in rivers. The only important river, the Murray, obtains its waters from the distant mountains of New South Wales and Victoria, and so much of the Murray water is lost by evaporation in South Australia that occasionally none of it is left to flow into the sea, and the sea water works its way

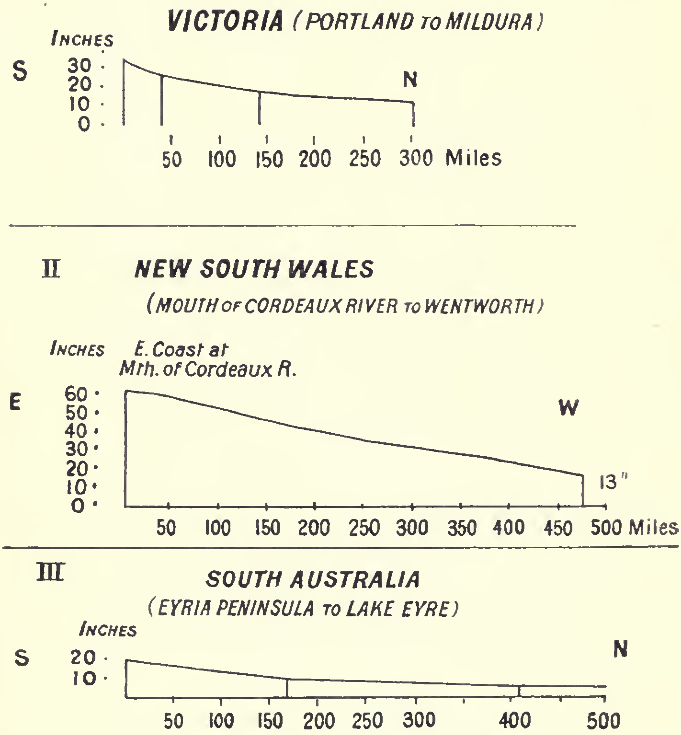

Fig. 7. Diagram showing the slow decrease of rainfall inland in South Australia as contrasted with Victoria and New South Wales.

through the mouth of the Murray some distance up the river channel.

Cooper Creek and the Diamantina, the two great rivers of north-eastern South Australia, occasionally receive great floods from the highlands and plains of Queensland. But their waters are lost by evaporation and as a rule their river beds are long tracts of clay and sand; occasional water pools, as Grayson Pool, on the Diamantina (Fig. 8), are maintained by the slow percolation of rain water into them from rain that has been stored up in adjacent higher ground.

VIII.—South Australia Moulded by Wind More than by Water.

Owing to the smallness of the rainfall and the absence of perennial streams, water plays a subordinate part in moulding the surface of South Australia; and the hills are worn away and their slopes smoothed by a natural sand blast, and the floors of the valleys filled by the accumulation of wind borne dust. The occasional storms of rain sweep the loose material into the hollows, where it is spread out to form plains that have the appearance of old lake basins; but, though pools occur on them after rain, these tracts of nearly level ground are not due to lakes but to the accumulation of material deposited by wind and rain. As there are no rivers to wear out deep valleys among the highlands, the country commonly shows a gently undulating surface and the only important bold mountain faces are the scarps formed by direct earth movements.

The most striking geographical feature of South Australia is therefore the predominance of its plains and basins, and they are of most value for agricultural and pastoral industries. Moreover, the most active geographical agents in South Australia are engaged in the burial of the ancient rocks beneath sheets of wind-borne drift instead of exposing them in river gorges; hence, except near the scarps of the great earth movements, the old rocks are often ill-exposed and their mineral wealth concealed, and the mining industry of South Australia, in spite of the importance of the copper mines along the scarp of the South Australian highlands, is of secondary importance. The State has very little coal, for the rocks containing the valuable coal seams of New South Wales are not present in South Australia. The arid climate, however, renders the soils rich in plant foods, as they are not constantly washed away by excessive rain.

South Australia is, therefore, mainly dependent upon agricultural and pastoral resources (see Fig. 1). The southern districts produce great wealth of grapes and wine. The plains in the hollows among the South Australian Highlands, being watered by rain that drains off the surrounding hills, raise rich crops of cheaply produced grain. But as the rainfall decreases to the north the forests disappear, so that the value of timber raised in South Australia is comparatively insignificant (Fig. 9), and the rich soils become less and less useful. Agriculture on a large scale becomes impossible, and the country is either left unoccupied or used only for grazing flocks of sheep and herds of cattle, and communication between the distant settlements is often possible only by camels. The interior of South Australia may therefore be described as mostly desert, using that term in its generally accepted modern meaning of a country with such an arid climate and such a scanty water supply that agricul-

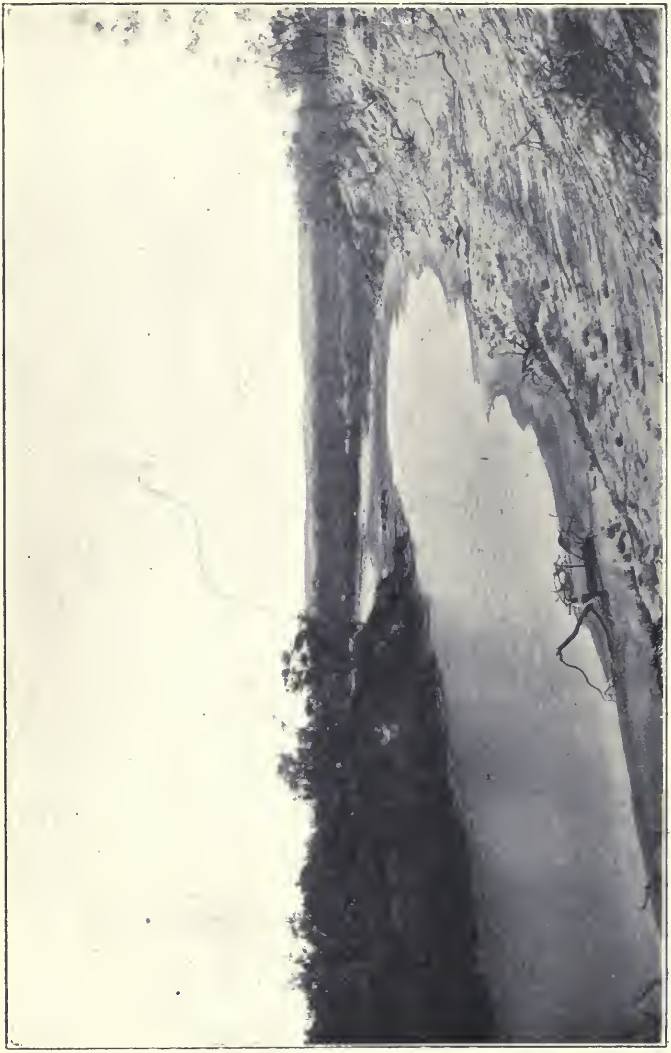

Fig. 8 Grayson Pool, on the Diamantina River.

ture is impracticable, and occupation is found possible only for a sparse population of pastoralists. This, it should be remembered, is the sense in which the term desert is used in the Bible, although Sir Walter Scott speaks of some of the Scotch moors as deserts, where the sparseness of population is often due to excessive rain, which keeps the soil so sodden with water that they cannot be profitably cultivated.

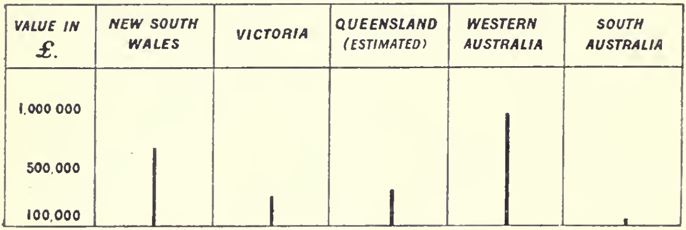

Fig. 9. The value of the timber cut in the five States in 1907.

IX.—The Influence of Plains on Character.

It is on these arid desert plains of South Australia that the most famous tragedies of Australian exploration have been enacted. There has been no difficulty in the exploration of the country from impenetrable jungles such as those which led to the disaster to Sir John Franklin's expedition in Tasmania, or from a maze of deep gorges such as delayed the surveys and exploration of the highlands of New South Wales and Victoria.

The survey of South Australia was comparatively simple for its wide plains and low hills are quickly traversed, its land-forms are large but low, and its geographical units are never intricate and confused. The one difficulty was the lack of water and the only danger that of drought drying up the water holes behind, and thus cutting off retreat. The explorers of the eastern States were rewarded by the discovery of pleasant countries, such as the plains of south-western Victoria or the Darling Downs, or they cruised easily down the Murray, or had the constant excitement of magnificent and ever-changing panoramas as they forced their way over cool mountainous highlands. The less fortunate explorers of South Australia have too often returned with records of a dreary journey, harassed at every step by the anxious search for water. Instead of bestowing on large districts such hopeful titles as Australia Felix, or calling the mountains the Alps and the Pyrenees after the most impressive features of European scenery, or christening the new found rivers after "the sweet vale of Avoca" or the Loddon, then the favourite tributary of the Thames, or "Proud Mersey, so great in ent'ring of the Main," or naming localities on the coast San Remo and Mentone, after famous holiday resorts on the Mediterranean, the map of South Australia has been sprinkled with such despondent names as Illusion Plains,* Mount Distant, Mount Deception, and Mount Hopeless. The story of South Australian exploration has many tragedies, such as the death of Henry

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*The appropriateness of this name was often justified: thus in 1857 Goyder, the Assistant Surveyor-General of South Australia, reported the existence of a great inland freshwater sea, which would solve the difficulties in the development of the interior; but an expedition with a boat for its navigation, proved the report to be based on mirage. Extracts from the original reports are reprinted in "The Dead Heart of Australia," pp. 253/256.

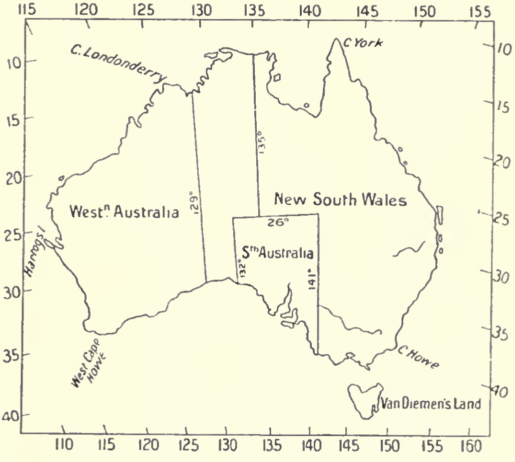
Bryan through giving up his horse to save Governor Gawler; Sturt's imprisonment at Depôt Camp; the death of Burke and Wills on Cooper Creek after having achieved the first crossing of Australia from south to north; and probably it was in or near the South Australian border that the Leichhardt expedition met its still unknown fate. There are also stirring stories of the conquest of great difficulties by the combination of forethought, courage, and bushmanship that safeguarded Eyre through his wonderful march around the Great Australian Bight, that carried the indomitable McDouall Stuart across the centre of the continent to the northern coast, that enabled Howitt to rescue the last survivor of Burke and Wills' ill-fated expedition.

South Australia, on first impressions, appears less attractive than the other States of the continent; for its lands are less pleasant than the rich turf-clad plains of south-western Victoria; it lacks the combination of snow-field and gum forest of the Australian Alps; its dry lakes, in spite of the alluring mirage, cannot compare with the varied beauty of the mountain lakes of Tasmania; and the weathering of its plateaus has produced nothing to rival the unique features of the Blue Mountains of New South Wales. Nevertheless, its long, low, open plains, with their gentle undulations, suggesting the freedom of the sea with the stability of land, have, to many men, an unequalled fascination. The plains such as the British Fens, the dyke-protected lowlands of Holland, the north German marshes, the plain of Lombardy, or the artificial upbuilt islands of Venice, have ever been the real home and safeguard of freedom and the most inspiring schools of character and liberal thought. Hence, although the short history of South Australia contains the most striking tragedies in the record of Australian exploration, and the development of the State is slower than with a mining community, it has many of the features most hopeful for Australia's future.

PART I.—HISTORICAL GEOGRAPHY.

CHAPTER I.—SITUATION, BOUNDARIES, AND EXTENT OF SOUTH AUSTRALIA.

SOUTH AUSTRALIA occupies a south-central position among the States of Australia. It has Queensland (in part), New South Wales, and Victoria on its eastern boundaries and Western Australia (in part) on its western. On the north, it is bounded by the Northern Territory; and on the south, by the Southern Ocean. South Australia is divided from the Northern Territory by the 26th parallel of south latitude.



Lands Dept., N.S.W.

Fig. 10. Political Divisions of Australia in 1836.

The territory originally granted by Royal Charter for the founding of the Province of South Australia was comprised between the 132nd and the 141st meridian of east longitude, and from the coast line on the south to the 26th parallel of south latitude on the north. Or roughly speaking, the limits were, Charlotte Waters on the north; a little west of Fowler Bay, on the west; and the eastern boundaries as at present, as far north as indicated above. (See Figs. 10 and 11.)

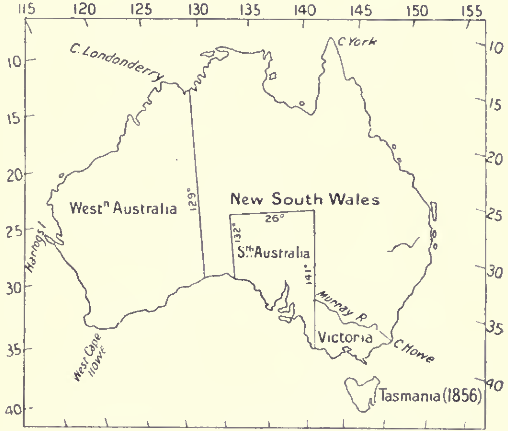


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Fig. 11. Political Divisions of Australia in 1855.

The lands held by the Colony were subsequently enlarged in two directions. (Figs. 12 and 13.) A strip of country, about 90 miles wide lying between South Australia and Western Australia, originally held by New South Wales, was in 1861 transferred by the Colonial Office to South Australia, extending its western boundaries to the 129th meridian of east longitude. Two years later, (1863), the country lying to the north of the 26th parallel of south latitude, extending to the north coast, was added to the Province of South Australia, under the name of the Northern Territory. The territory thus attached had not quite the same breadth as the southern portions, so that the eastern boundaries of South Australia at that time were on the 138th meridian of east longitude, to the north of the 26th parallel of latitude; and on the 141st meridian of longitude, to the south of that line.

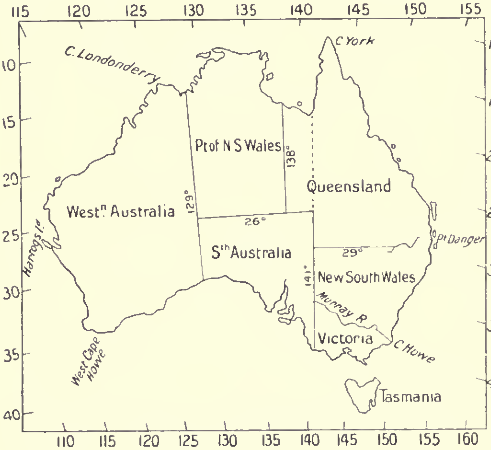

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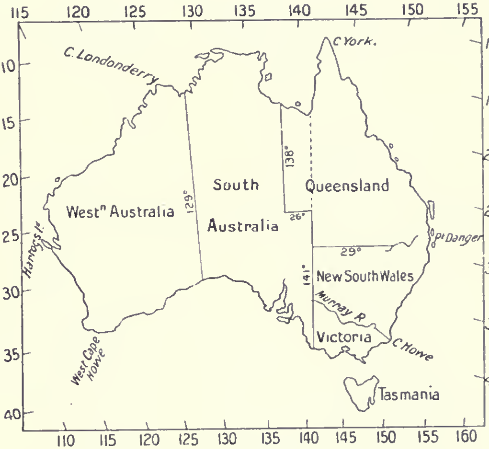
Fig. 12. Political Divisions of Australia in 1861.

When more exact methods of determining longitude became available it was found that the boundary line fixed between South Australia and Victoria involved an error of two miles in breadth, and that there was an encroachment to this extent on South Australian territory. This proved a subject of dispute between the two States concerned for a number of years. The question was submitted for adjudication to the

Privy Council, and in 1914 a verdict was obtained in favour of Victoria.

From 1863 to January 1st, 1911, the Northern Territory formed a part of South Australia, but, by mutual consent, on the last date mentioned the Federal Government took over the control of the Northern Territory, by which, from being second in size among the Australian States, South Australia was reduced to a fourth position, as will be seen by the following table:—



Lands Dept., N.S.W.

Fig. 13. Political Divisions of Australia in 1863.
As stated in the text the present northern boundary is the 26° parallel of S. Lat.

State	Area in Square Miles	State	Area in Square Miles
Western Australia ...	975,920	New South Wales ...	309,460
Queensland ...	670,500	Victoria	87,884
Northern Territory ...	523,620	Tasmania ...	26,215
South Australia ...	380,070	Fed. Capital Territory	912

CHAPTER II.—DISCOVERY AND COLONISATION OF SOUTH AUSTRALIA.

A Dutch captain, named **Pieter Nuyts**, in command of the *Gulde Zeepaert*, has the honour of discovering the south coast of Australia, an event which took place in the year 1627. He followed the coast of the Great Australian Bight for several hundred miles, probably as far as Fowler Bay and Nuyts Archipelago, and named it Nuyts Land, a name which is now limited to Nuyts Reefs, Cape Nuyts, and Nuyts Archipelago. The country was described by the Dutch navigator as " inhospitable and barren."

About 1792 a French officer, **D'Entrecasteaux**, visited the southern seas of Australia with the double purpose of looking for the explorer **La Perouse**, who had been lost sight of for a number of years, and also to make further explorations in those quarters. He describes the cliffs of the Great Bight as exhibiting "an aspect so uniform that the most fruitful imagination could find nothing to say of it."

Lieutenant Grant, on his way out to Botany Bay in the *Lady Nelson*, a small craft of 60 tons burthen, discovered and named Cape Banks, Cape Northumberland, Mount Gambier and Mount Schank. This discovery was made on December 3, 1800. The centenary of this event was celebrated in the erection by public subscription of "a Centenary Memorial Tower," on the summit of Mount Gambier.

More important explorations of the southern coast were made by **Captain Matthew Flinders** (Fig. 14) in the *Investigator*, who reached Cape Leeuwin about the end of 1801. Flinders sailed along the coast of the

Great Bight and named Fowler Bay, Smoky Bay, Streaky Bay, Anxious Bay, Port Lincoln and other places. The wreck of a cutter belonging to the ship and the loss of all hands induced Flinders to name one of the southern headlands of the peninsula, Cape Catastrophe. Referring to this event he writes, "I caused an inscription to be engraved upon a sheet of

Fig. 14. Captain Flinders.

copper, and set it up on a stout post at the head of the cove, which I named Memory Cove, (Fig. 15) and further to commemorate our loss, I gave each of the six islands nearest to Cape Catastrophe the names of one of the seamen.'' This memorial plate, in a dilapidated condition, is preserved in the Adelaide Public Library, and a photograph of the same. restored, will be found at Fig. 16. Flinders then sailed in a north-westerly direction up the great inlet of the sea, which he named Spencer Gulf, but was disappointed in not finding a through passage or important river at its head. Returning southwards he rounded the southern end of Yorke Peninsula, giving names to Investigator Strait, Kangaroo Island, (so named from the number and tameness of the kangaroos found on it), Point Marsden, Nepean Bay and other prominent features. Continuing his voyage up the eastern inlet, which he designated Saint Vincent Gulf, a high range of hills was noted on the eastern mainland, the highest point of which he named Mount Lofty.

After exploring St. Vincent Gulf, Flinders passed out by the eastern, or Backstairs Passage, rounded the headland, which he named Cape Jervis, and continuing to steer along the coast, entered the bay which is sheltered by Rosetta Head and Granite Island. On the eastern side of the bay, and not far from the mouth of the River Murray, Flinders encountered the French exploring ship *Le Géographe*, under the command of **Captain Baudin,** and as France and England at that time were supposed to be at war, Flinders judiciously manœuvred his vessel so as to keep a broadside directed towards the French ship, ready for action,

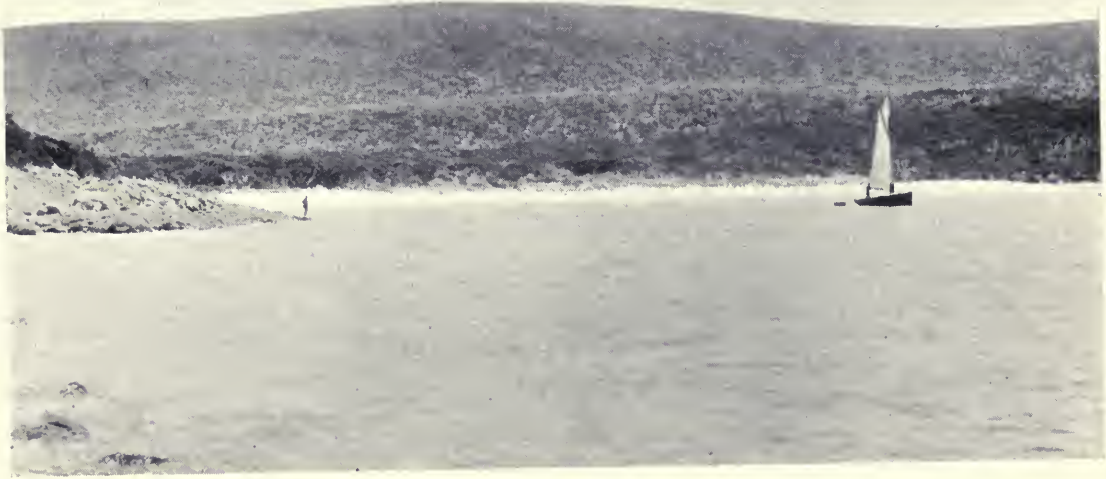
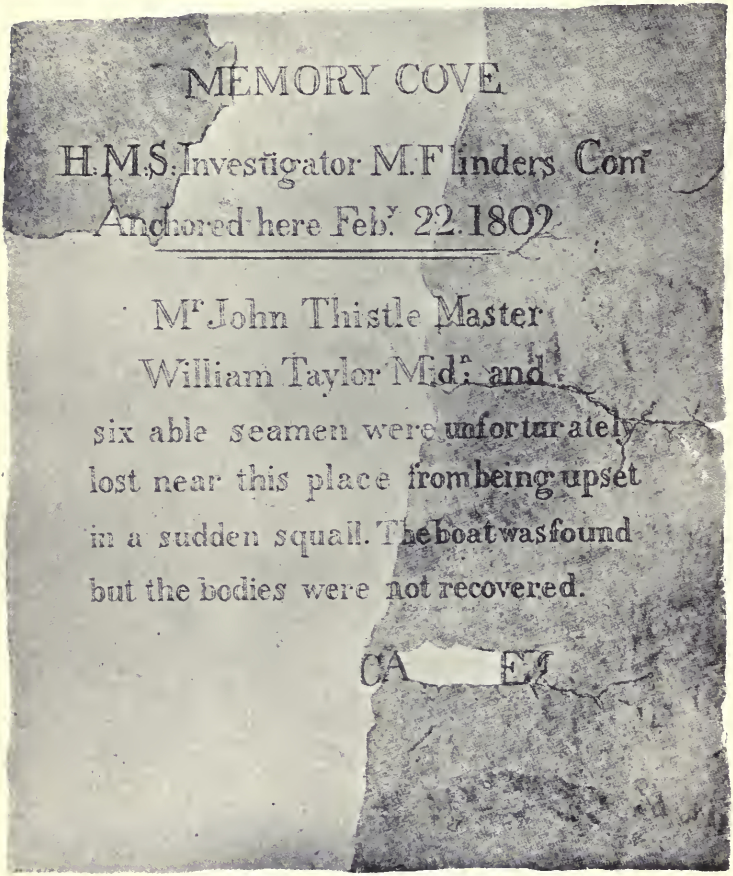


Fig. 15. Memory Cove.

should the emergency arise. Fortunately friendly relations were established between the two commanders



MEMORY COVE

H.M.S. Investigator M. Flinders Comr

Anchored here Feby 22. 1802

Mr John Thistle Master

William Taylor Midn and

six able seamen were unfortunately

lost near this place from being upset

in a sudden squall. The boat was found

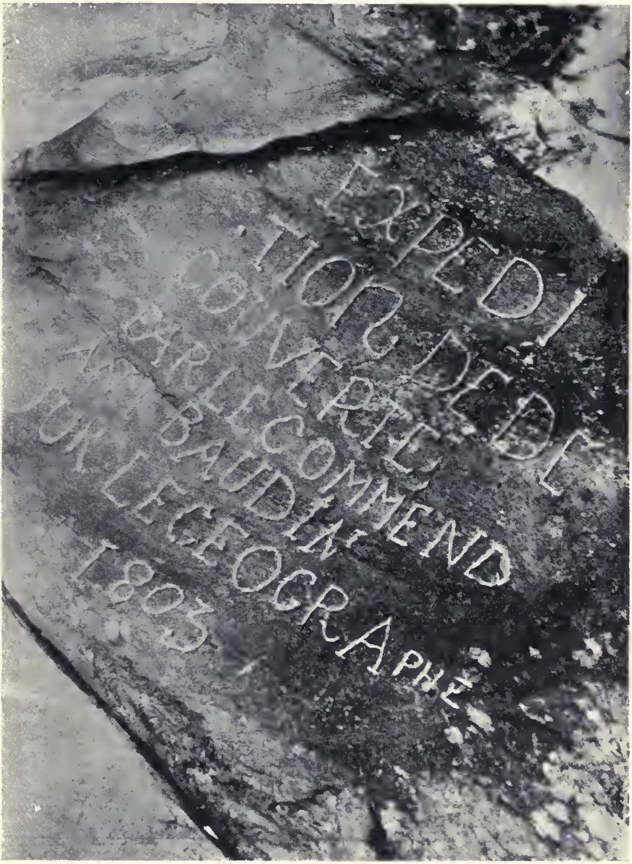
but the bodies were not recovered.

CA E

Fig. 16. Copy of Copper Plate erected by Flinders at Memory Cove. (The dark portions are from pieces of the original plate now in the Public Library, Adelaide; the other portion is only conjectural.)

and Flinders gave the name Encounter Bay to the scene of the event.

An interesting relic of Captain Baudin's visit to South Australian waters is left in "the Frenchman's Rock," at Hog Bay, Kangaroo Island, an inscription having been cut by one of the crew of the *Le Géographe* on an exposed face of the rock, a few feet

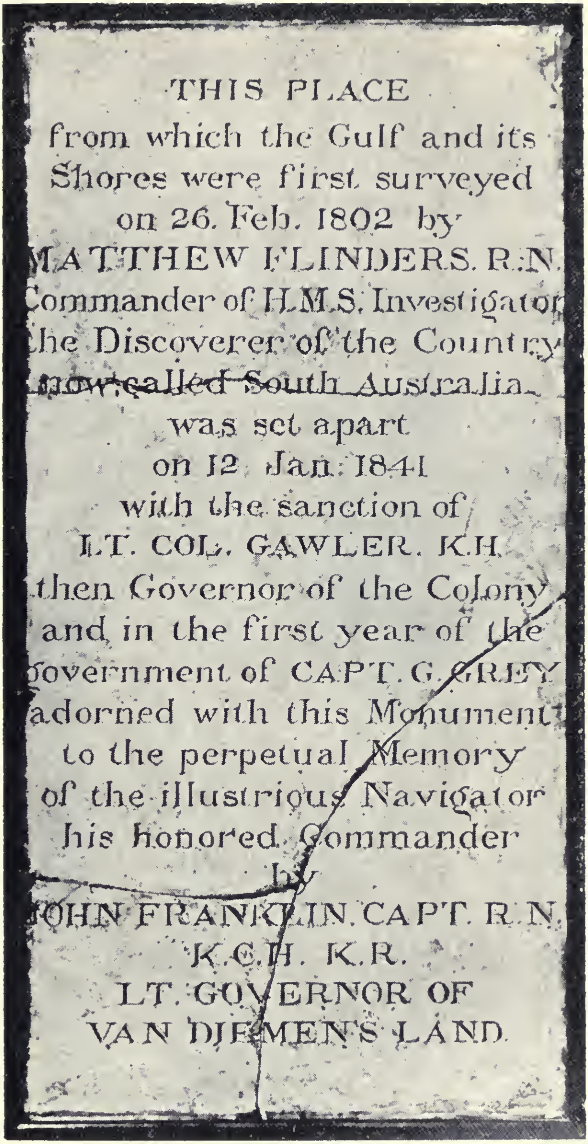


S.A. Govt. Photo.

Fig. 17. Frenchman's Rock, Hog Bay, Kangaroo Island.

above sea level. (See Fig. 17). But for Flinders's timely explorations and planting the British flag along the southern shores of Australia, that part of the continent would probably now have been a French possession. The geographical names which the seas, inlets, coastal features, and prominent landmarks of South Australia bear, supply abundant evidence of the important work done by Flinders in the determination of the southern coast-lines of the State. Sir John Franklin, when Governor of Van Diemen Land, erected a monument to Flinders on Stamford Hill, near Port Lincoln, which has of late years been replaced by a new one, the original tablet, of which Fig. 18 is a photograph, having been deposited in the Public Library in Adelaide. A column 50 feet high has also been erected on the top of Mount Lofty in memory of this great navigator who named the mount and was the first to explore the entire coast-line of South Australia.

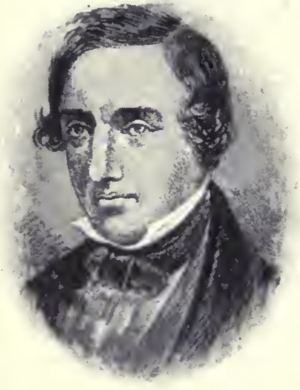
The name of **Captain Charles Sturt** (Fig. 19) is intimately connected with the discovery of the great waterways of the Darling and the Murray Rivers. In 1828 Sturt left Sydney with the object of exploring the network of creeks and rivers which drain the western sides of the watershed of the east coast. In this journey Sturt discovered the Darling, but a severe and prolonged drought made it impossible for him to follow up his discoveries, and he had reluctantly to return to Sydney. In November of the following year Sturt made another attempt, but by a new route, this time endeavouring to reach the interior by descending the upper waters of the Murrumbidgee. Finding the country impracticable



THIS PLACE
from which the Gulf and its
Shores were first surveyed
on 26. Feb. 1802 by
MATTHEW FLINDERS. R.N.
Commander of H.M.S. Investigator
the Discoverer of the Country
now called South Australia
was set apart
on 12 Jan. 1841
with the sanction of
LT. COL. GAWLER. K.H.
then Governor of the Colony
and in the first year of the
government of CAPT. G. GREY
adorned with this Monument
to the perpetual Memory
of the illustrious Navigator
his honored Commander
by
JOHN FRANKLIN. CAPT. R.N.
K.C.H. K.R.
LT. GOVERNOR OF
VAN DIEMEN'S LAND.

Fig. 18. Copy of Original Tablet on the Monument at Stamford Hill, near Port Lincoln. South Australia.

to wheeled conveyances, Sturt sent his teams back, and by means of the whaleboat, which he had brought with him in sections, and another smaller boat which was constructed by felling trees on the spot, the little party of eight took the bold step of risking everything by floating down stream, not knowing whither the river might take them. They took to their boats on January 7, 1830. The voyage was made under great difficulties, and not the least was the impetuosity of the current which constantly threatened to upset the boats in violent impact against the numerous snags which obstructed the river's bed. In one of the most rapid of these reaches, Sturt was astonished to find himself suddenly on the surface of a magnificent river: "the boats," he says, "were allowed to drift along at pleasure whilst we continued to gaze in silent astonishment on the capacious channel we had entered." The explorer named this noblest of Australian inland waterways, the Murray, after Sir George Murray, who at that time was head of the Colonial Department. Continuing down stream, the junction of the Darling with the Murray was observed, Sturt correctly surmising that they were "now sailing on the bosom of



Picturesque Atlas Co.

Fig. 19. Captain Charles Sturt.

that very stream from whose banks he had been twice forced to retire." On February 9th, thirty-three days after taking to the boats, they entered the Lakes at the outlet of the Murray, but found the mouth of the river too shallow to be navigable.

The task that remained to this small crew was a critical one. They had to retrace their steps. With weakened constitutions and provisions reduced to half rations, they had to navigate the stream against a powerful current, and, moreover, to run the gauntlet of numerous native tribes which had shown a hostile disposition towards the explorers in their downward voyage. That return journey was one of great hardships—one of the party lost his reason. It was not until the 18th of April, when in their last extremity, that relief reached them. This journey of Captain Sturt and his small band of heroes, in which they had completed a voyage of 2,000 miles under great perils and suffering, stands out as one of the most striking and momentous chapters in Australian exploration. Captain Flinders, on the coast, and Captain Sturt on Australia's great waterway, must be regarded as the chief agents in preparing the way for the colonisation of the land that is now the State of South Australia.

The first martyr to the cause of South Australian exploration was **Captain Collet Barker**, who on a voyage between King George Sound and Sydney, in 1832, entered Gulf St. Vincent with the object of determining whether the waters of Lake Alexandrina found an outlet westward into the Gulf. Not finding such an outlet, Captain Barker, accompanied by six of his crew, crossed the Mount Lofty Ranges, and after exploring Lake Alexandrina, the captain courageously swam across the Murray, near its mouth, and was speared by natives as he landed on the opposite side. His name is perpetuated in Mount Barker which he discovered during this journey.

Founding the Colony.

Long before there was a definite effort to establish a colony on the south coast, a few individuals had found their way to its shores and lived solitary and rough lives amidst its wilds. The first to take this step was **Thomas Whalley,*** who left the *General Gates,* a whaling ship which was in South Australian waters, in 1816. He settled on Kangaroo Island near the present township of Queenscliffe. By Whalley's persuasions Billy Day, one of the crew of another whaler which visited the island two years later, was induced to desert his ship and join him. These settlers were subsequently joined by others who were principally escaped convicts and deserters. An old settler, named George Bates, who at the age of 95 died in the Destitute Asylum in Adelaide, was by his own statement, living on Kangaroo Island in 1824, and took part in the search for Captain Barker while the fate of this unfortunate explorer was unknown.

What the early navigators saw of the land was slight, and not such as would create an enthusiasm to undertake its subjugation. Flinders gave a guarded description of its soil, and went so far as to say, "The soil of that part of Kangaroo Island examined by us was judged to be much superior to any before seen, either upon the south coast of the continent, or upon the islands near it." Those who accompanied Captain Barker, in his fatal journey, spoke in glowing terms of the Mount Lofty Ranges and the Inman Valley, by way of which they returned to their ship. The great discoveries made by Captain Sturt that the Darling and the Murray were navigable rivers for many miles, running up into the heart of the country, created some excitement in Britain, and shortly afterwards steps were taken with the view of founding a colony in the new lands brought to light by Flinders and Sturt.

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*The name of this man occurs variously as Thomas Whalley, Wally, Robert Warlans, and Walker, and on the arrival of the first emigrant ship he was found to bear the sobriquet of "Governor."

The first attempt at colonisation was made in 1831 but ended in failure. A committee was formed in London, a number of intending emigrants were enrolled and lengthy negotiations opened up with the British Government, with a view to obtaining the necessary Charter for the colony, but the Government withheld its sanction.

Three years later (1834), a new organisation was formed for the same object, under the name of "The South Australian Association." The Association consisted of twenty-nine gentlemen, eighteen of whom were members of Parliament. To give the scheme publicity, a meeting was held in Exeter Hall. The leaders were greatly influenced by the principles of colonisation advocated by **Edward Gibbon Wakefield** (Fig. 20), who was warmly supported by **Colonel Torrens** (Fig. 21), the latter being the chief exponent of the System at the Exeter Hall meeting. The object of the Wakefield System was to avoid the errors with which previous attempts at colonisation had been attended. There was to be no convict-labour, or admission of convicts from any outside source. Land was not to be given away in great blocks to favoured individuals, as had been the case in the founding of some of the Australian Colonies, but the land must be sold at a fixed minimum price, or as much more as it would fetch at public auction. The money obtained by this means by the State was to be devoted to the introduction of suitable immigrants, whereby a constant increase of population would be secured for the development of the resources of the colony. Other principles laid down as the basis of its foundation were, that the colony should not be a charge on the Home Government, and that no State Church should be recognised.

Fig 20. Edward Gibbon Wakefield.

Through the energetic action of this "Association" the Imperial Parliament, in August 1834, passed an Act which authorised the founding of a Colony as projected by the promoters. The Act defined the limits of the proposed settlement and provided that all persons residing within the newly constituted Province should be free from the jurisdiction of the other

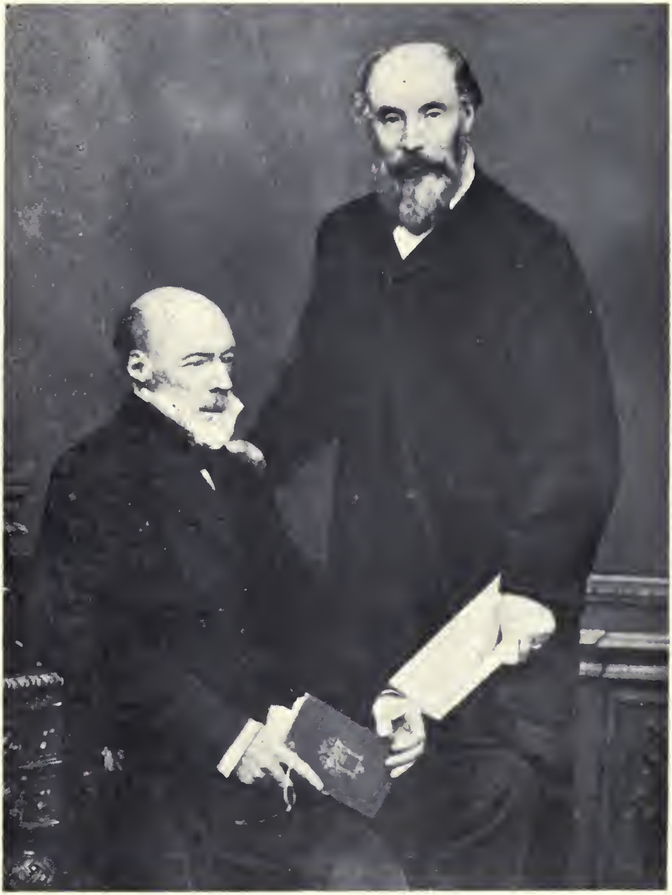

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Fig. 21. Colonel Torrens (seated), Chairman of the first Board of Commissioners. Sir R. R. Torrens (standing), son of Colonel Torrens, and author of the Torrens Real Property Act.

Australian colonies; it gave power to persons approved by the Crown, and resident in the Province, to frame laws, establish Courts, appoint officers, chaplains, and clergymen of the Church of England or of Scotland, and to levy such duties and taxes as might be requisite for the well-being of the colony. It was further provided that three or more Commissioners, appointed by the Crown, should be an Executive to see that the Act was duly carried out and to superintend the survey and sale of Government lands. The caution with which the Home Government moved is seen, in that, before the Commissioners could take definite steps in founding the colony, they had to produce a deposit of £20,000 as security, and show that land to the value of £35,000 had been sold. And further, should the population of the colony, after ten years of settlement, be less than 20,000, it was provided that the unsold lands should revert to the Crown.

The first Commissioners appointed under the Act were: Colonel Torrens (Chairman), George Fife Angas, Edward Barnard, George Barnes, W. Hutt, M.P., J. G. Shaw Lefevre, W. A. Mackinnon M.P., Samuel Mills, Jacob Montefiore, George Palmer, jun., John Wright, and Rowland Hill who acted as Secretary. The name of each of the Commissioners has been perpetuated in the names of the streets or prominent features of Adelaide.

At this stage the movement was on the point of failure on financial grounds. The Commissioners had fixed the price of the land at £1 per acre, to be sold in eighty acre blocks of country land, the purchaser to possess the right of securing one acre of town land at the same rate, or £81 in all. But some difficulty was found in selling land at the antipodes, as the purchaser had no opportunity of inspecting or estimating the value of his purchase.

At this critical juncture one of the Commissioners, **George Fife Angas** (Fig. 22), succeeded in forming an Association which took the name of the South Australian Company, the object of which was to find the funds necessary to proceed with the movement. Angas resigned his Commissionership to

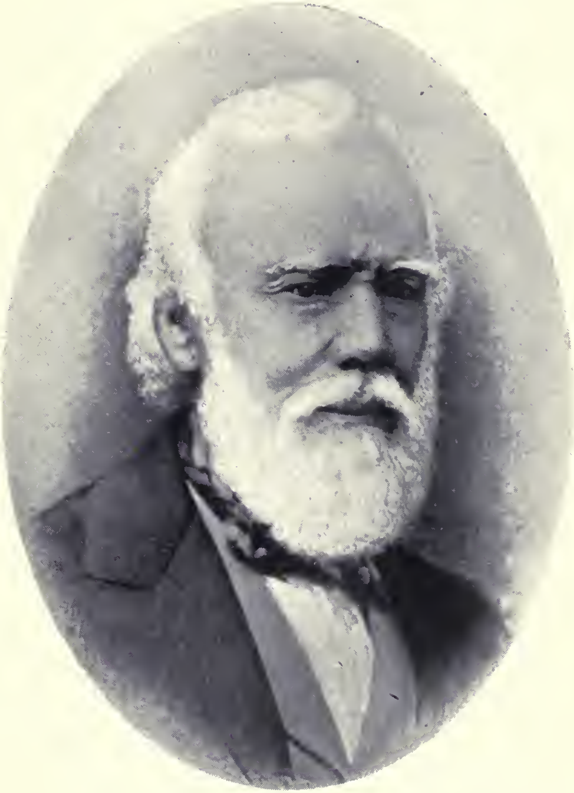

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Fig. 22. George Fife Angas.

become the Chairman of the Company, and devoted a large amount of his private means in securing the establishment of the infant colony. The Company thus formed offered to purchase the balance of the land required to meet the conditions of the Act, at the reduced rate of 12s. per acre. This was accepted and active measures were immediately taken to give effect to the scheme.

The barque, *Duke of York*, 197 tons, with 38 adult passengers and four children on board, was the pioneer immigrant ship to arrive in South Australian waters. She anchored in Nepean Bay, Kangaroo Island on July 27th 1836. The first settlement was at Kingscote, where there still can be seen the evidences of such early occupation in scattered bricks of English manufacture, a few fruit-trees, and an enclosed cemetery which records the names of some of these early settlers. During the same year eight other immigrants ships arrived, the last of which, the *Buffalo*, had on board 174 passengers including **Captain** (afterwards Sir John) **Hindmarsh**, R.N., the first Governor of South Australia. The *Buffalo* anchored in Holdfast Bay on December 28th, the immigrants landing on the same day, and under the shade of a gum tree, which though much bent, is still living (Fig. 23), the Union Jack was hoisted, salutes fired, official documents read, and the Colony proclaimed. A considerable number of settlers had preceded the *Buffalo* in occupation of Holdfast Bay, where a temporary settlement had been formed. The number of persons present at the ceremony of proclaiming the colony is variously stated at 200 and 300, including James H. Fisher, who had been

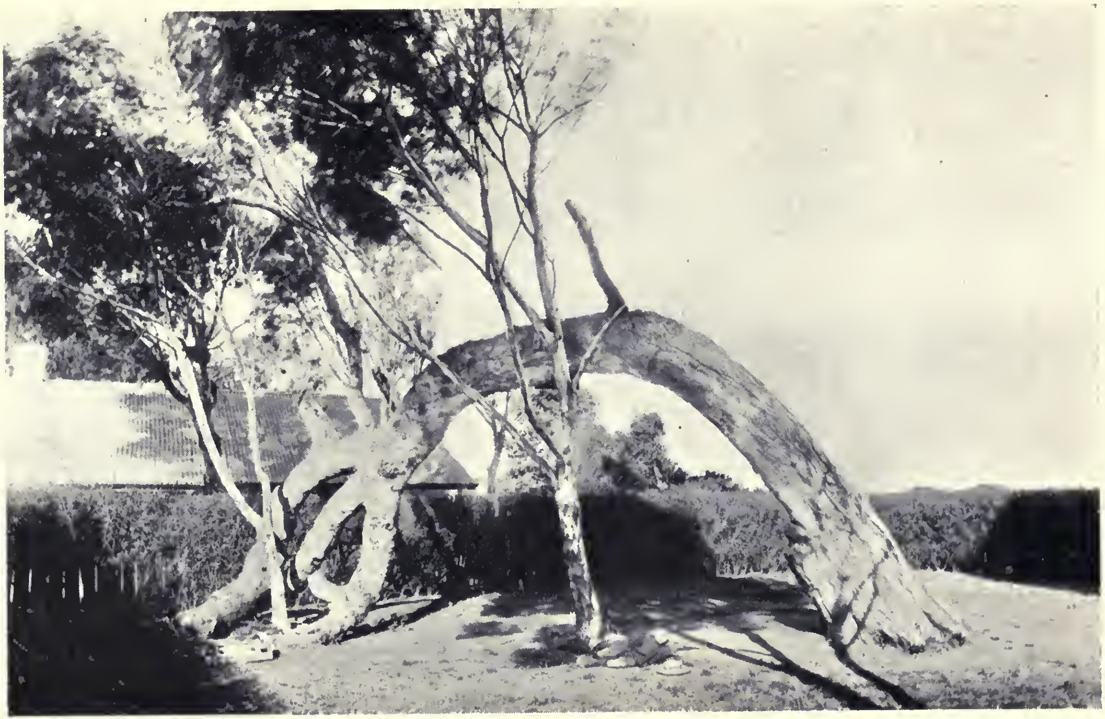

Fig. 23. Old Gum Tree under which the Colony was Proclaimed on December 28, 1836.

appointed Resident Commissioner. The following is a copy, and as near as possible, a facsimile of the Proclamation:—

PROCLAMATION

By His Excellency John Hindmarsh, Knight of the Royal
Hanoverian Guelphic Order, Governor and Commander-in-Chief of
HIS MAJESTY'S PROVINCE
of
SOUTH AUSTRALIA.

In announcing to the COLONISTS of HIS MAJESTY'S PROVINCE of South Australia the establishment of the Government, I hereby call upon them to conduct themselves on all occasions with order and quietness, duly to respect the laws, and by a course of industry and sobriety, by the practice of sound morality and a strict observance of the Ordinances of Religion, to prove themselves worthy to be FOUNDERS of a great and free Colony.

It is also, at this time especially, my duty to apprise the Colonists of my resolution to take every lawful means for extending the same protection to the NATIVE POPULATION as to the rest of His Majesty's Subjects, and of my firm determination to punish with exemplary severity all acts of violence or injustice which may in any manner be practised or attempted against the NATIVES, who are to be considered as much under the Safeguard of the law as the Colonists themselves, and equally entitled to the privileges of British Subjects. I trust, therefore, with confidence to the exercise of moderation and forbearance by all Classes in their intercourse with the NATIVE INHABITANTS, and that they will omit no opportunity of assisting me to fulfil His Majesty's most gracious and benevolent intentions towards them by promoting their advancement in civilization, and ultimately, under the blessing of Divine Providence, their conversion to the Christian Faith.

By His Excellency's Command.

ROBERT GOUGER, Colonial Secretary.

Glenelg, 28th December, 1836.

GOD SAVE THE KING.

Glenelg: Printed by Authority by Robert Thomas and Co.
Government Printers.

CHAPTER III.—REFERENCES TO LITERATURE.

The following are some of the principal original contributions dealing with the discovery of South Australia and explorations into its interior:—

JAS. GRANT.—Narrative of a Voyage of Discovery performed in H.M. Vessel, *The Lady Nelson*, in the years 1800-1802. 4to. London 1803

MATTHEW FLINDERS.—A Voyage to Terra Australis, undertaken for the purpose of completing the discovery of that vast country and prosecuted in the years 1801-1803, in H.M. ship *The Investigator*, &c. 2 vols. 4to. and Atlas. London 1814

COLLET BARKER.—Examination of the South Australian Coast from Cape Jervis to near the Semaphore, in April 1831. (See Sturt's Expeditions, Vol. II., pp. 231-248).

CHARLES STURT.—Two Expeditions into the Interior of Southern Australia during the years 1828-1831. 2vols. 8vo. London 1833

ED. J. EYRE.—Journey Overland from Sydney to Adelaide with stock, Nov. 8, 1837 to July 13, 1838. *S. Aus. Record*, Vol. I., p. 141.

————. Journals of Expeditions of Discovery into Central Australia and overland from Adelaide to King George's Sound in the years 1840-1841. 2 vols. 8vo. London 1845

CHARLES STURT.—Narrative of an Expedition into Central Australia, performed under the authority of H.M. Government during the years 1844-1846, together with a notice of the Province of South Australia in 1847. 2 vols. 8vo. London 1849

J. MCDOUALL STUART.—Explorations across the Continent of Australia. With Charts. 1861-1862. fscp. 8vo. Melbourne 1863

———— Explorations in Australia. The Journals of J. McDouall Stuart during the years 1858-1862, when he fixed the centre of the Continent, and successfully crossed it from sea to sea. 8vo. London 1864

The following are some of the principal compilations dealing with the discovery, early history, and settlement of South Australia:—

R. Torrens.—Colonization of South Australia. 8vo. London 1835

F. S. Dutton.—South Australia and its Mines with an Historical Sketch of the Colony. 8vo. London 1846

R. H. Major.—Early Voyages to Terra Australis. (Hakluyt Society Vol. XXV.) 8vo. London 1859

W. Harcus.—South Australia: its History, Resources, and Productions. 8vo. Adelaide 1876

Capt. Musgrave.—Précis of Information concerning the Colony of South Australia. 8vo. Adelaide 1876

A. & G. Sutherland.—History of Australia from 1606 to 1876. 8vo. Melb. Syd. & Ad. 1879

Thos. Worsnop.—History of the City of Adelaide from the Foundation of the Province of South Australia in 1836 to 1877. 8vo. Adelaide 1878

B. T. Finniss.—Constitutional History of South Australia during Twenty-one Years from the Foundation of the Settlement in 1836 to the Inauguration of Responsible Government in 1857. 8vo. Ad. and London 1886

John F. Conigrave.—South Australia. Handbook Compiled for Colonial and Indian Exhibition in London in 1886. 8vo. Adelaide 1886

Ernest Favenc.—The History of Australian Exploration from 1788 to 1888. 8vo. Sydney 1888

Edwin Hodder.—The History of South Australia from its Foundation to the Year of its Jubilee. 2 vols. 8vo. London 1893

Jas. D. Woods.—The Province of South Australia, written for the South Australian Government. 8vo. Adelaide 1894

David J. Gordon.—The Central State, its History, Progress and Resources. 4to. Adelaide 1903

(A very complete bibliography of South Australia up to 1886, was compiled by Mr. Thos. Gill, for the Colonial and Indian Exhibition, held in London, in 1886. Printed by the Government Printer, Adelaide the same year. Also a bibliography of the Northern Territory of South Australia up to March, 1903.) Adelaide 1903

PART II.—PHYSICAL GEOGRAPHY.

CHAPTER I.—THE SOUTH AUSTRALIAN COAST.

Continental Shelf.—All the great continents are surrounded by a zone of comparatively shallow water of variable width, with a depth extending to about five or six hundred feet, the limit of which is known as the hundred fathom line. Beyond this shallow zone the sea bottom usually drops somewhat steeply to the profound depths of the ocean. These marginal shallows around the land are known as the Continental shelf, and they form the disputed area between land and sea. The sea widens the shelf, by encroachments on the land; and the wash from the land accumulates upon the sea bottom, producing, if not counteracted by other agencies, a shallowing of the sea. Such a Continental shelf surrounds Australia (Fig. 24), with a breadth of from twelve miles to 150 miles, beyond which, except on the northern side where the Continental shelf includes New Guinea and its dependent islands, the sea bed slopes rapidly to about 15,000 feet. The shallow sea margins have a much greater extent along the southern coast of Australia, than on either its eastern or western side; this fact arises from the encroachments of the sea at the Great Bight, and also from the hundred fathom line trending to the south of Tasmania, thus forming an extensive promontory of land and shallow seas a thousand miles in length. Numerous oscillations between land and sea have occurred along this margin in comparatively recent times. Parallel to the southern coast of Australia there

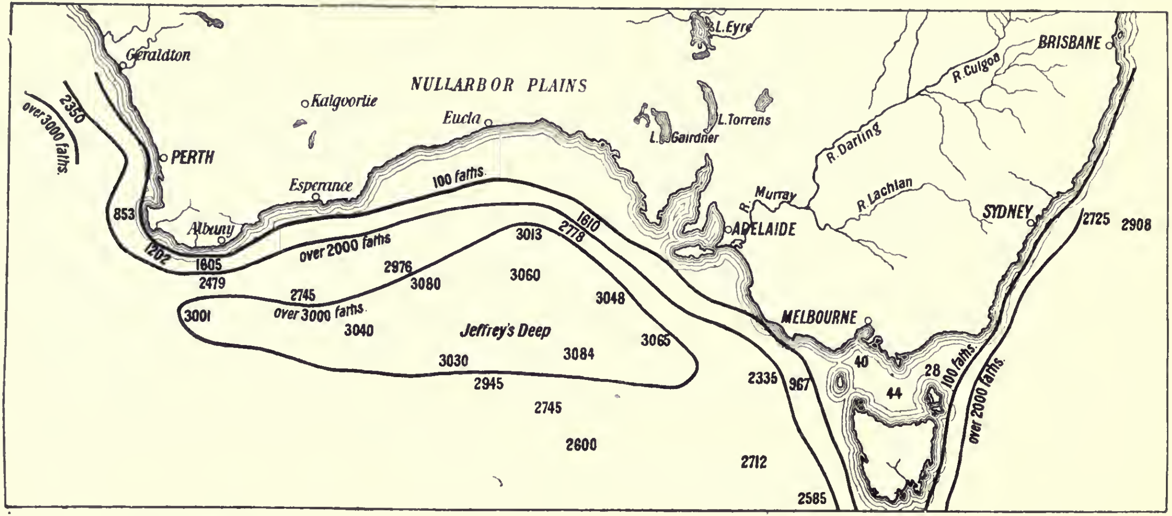

Fig. 24. Map to illustrate Depth of Ocean on Southern Coasts of Australia. (Based on Admiralty Chart.)

is a narrow trough, known as **Jeffrey's Deep** (Figs. 24, 25), which has a depth from the surface of 3,084 fathoms, or nearly four miles. The origin of this great trough no doubt stands related to the continental structure. Between land and ocean there are gravitational adjustments constantly in progress. The elevation of the southern seaboard, and the subsidence of the great rift-valley of South Australia, were earth movements that were complementary to each other. It is not improbable that the subsidence of the rift valley and the formation of Jeffrey's Deep stand related as parts of the same earth movements.

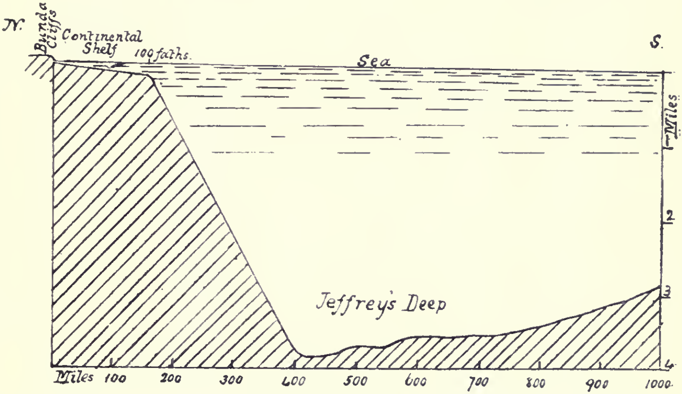

Fig. 25. Section across Great Australian Bight, showing Continental Shelf and Jeffrey's Deep

General Features.—The southern coast of South Australia has a general trend to the south-east, and is much indented by encroachments of the sea, so that while covering only twelve degrees of longitude, the coast line is 1,540 miles in length. It is naturally divisible into three sections: the Great Bight, the

Gulfs, and the South-East. The western boundaries of the State are about 130 miles to the west of the Head of the Great Bight, and the great coastal curve, made by the Bight, includes more than half the breadth of the State in an east and west direction. The coast, along the western side and Head of the Bight, is remarkably uniform and unbroken; and maintains an even curve, on the eastern side, to Nuyts Reefs and Point Fowler. From the latter, for 300 miles, the coast becomes an intricate and ever-changing contour of headlands, islands, bays, and inlets, to the extremity of Eyre Peninsula.

Two great inlets of the sea, Spencer Gulf and St. Vincent Gulf, indent the coast; the former running up into the land for a distance of nearly 200 miles, and the latter about 100 miles. These give rise to three important peninsulas: Eyre Peninsula, between the Great Bight and Spencer Gulf; Yorke Peninsula, with the shape of a leg and foot, dividing Spencer Gulf from St. Vincent Gulf; and Cape Jervis Peninsula, on the eastern side of the last named Gulf. Numerous islands and small archipelagoes occur at the entrance to Spencer Gulf, as the Neptunes, Gambier Island, a group near Cape Catastrophe, of which Thistle Island is the principal; and Sir Joseph Banks Group, consisting of 20 islands. Kangaroo Island lying to the south of St. Vincent Gulf divides the entrance to the latter Gulf into two. Investigator Strait (named after Flinders's vessel), forms the western entrance to the gulf, 23 miles wide, and has a wide fairway for shipping, with only the Althorpes Islands (on the northern side), within the channel. Backstairs Passage forms the eastern channel of communication into the gulf, and has a breadth of about ten miles.

After passing Backstairs Passage and rounding Newland and Rosetta Heads, Encounter Bay is entered, where Flinders met the French Exploring Expedition under Captain Baudin in what happily proved a peaceful "encounter." Encounter Bay forms the northern extremity of a long uniform coastal curve of over 100 miles, parallel with the Coorong, and terminating in the bold headland of Cape Jaffa, which forms Lacepede Bay on its northern and Guichen Bay on its southern side. At the south end of Guichen Bay is Cape Dombey, on which Robe is pleasantly situated. The coast continues in a south-easterly direction with few special features to Carpenter Rocks and Cape Banks, the only important break in this regular coast line being that of Rivoli Bay, situated about midway between Cape Dombey and Cape Banks. From the last named point the coast runs more easterly to Cape Northumberland, on which is an important lighthouse, and then, due east, with McDonnell Bay and a few other slight indentations of the coast, to the Victorian borders at the western side of Discovery Bay.

Physical Features of the Southern Coast.—The Great Australian Bight owes its existence to the relatively rapid waste of a chalky limestone of marine origin. The sea of the older Kainozoic period penetrated inland, much beyond the present coast-line, and laid down deposits 500 feet in thickness. This old sea-bed has since been raised into an extensive plateau and is gradually being worn away by the force of the waves. The horizontal position of the beds and their uniform character has led to a uniform waste. Wilson Bluff (Fig. 26), close to the Western Australian border, is a nearly perpendicular cliff, 250 feet in height, with a low rise inland to 290 feet at the summit level of the Eucla Road. These chalky cliffs preserve a continuous and perpendicular scarp for 127 miles, and terminate only within three miles of the Head of the Great Bight, where they are 145 feet in height. The country is arid and almost waterless. It was along the top of these cliffs, which afforded no access to the sea, that the explorer, Eyre, suffered extreme hardships. The coast is equally inhospitable for shipping, as there are no landing places, and no anchorage is known between Eucla and Fowler Bay, a distance of over 300 miles.

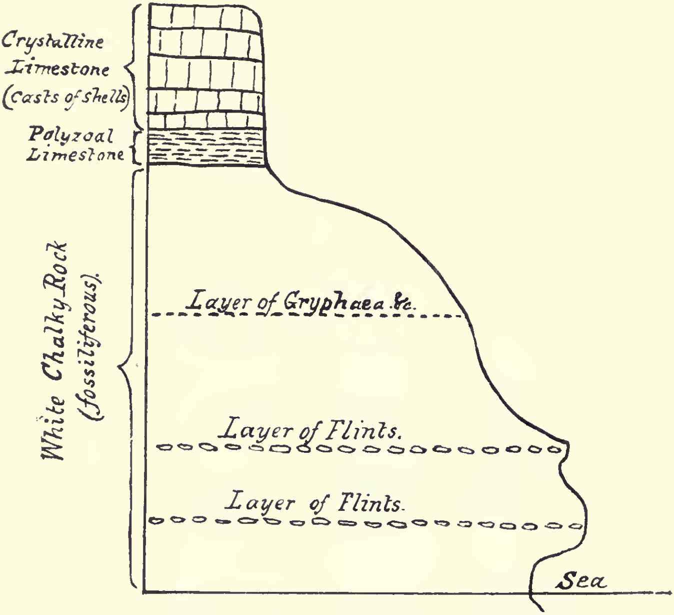

Fig. 26. Section of Wilson Bluff (250 feet), Great Australian Bight.

At the Head of the Great Bight, the Kainozoic limestones are obscured by hills of blown sand, which extend for over a mile inland, and reach an elevation of 186 feet. Such is the general character of the coast as far as Fowler Bay. The waste of the granitic rocks, which form the bed rock of the country, has supplied the sand; while a calcareous material obtained by the breaking down and solution of the Kainozoic limestones, has cemented the sand, in places, into a calcareous sandrock, or has laid down from solution a crust of travertine limestone. These recently formed rocks often exhibit sufficient resistance to sea-action to form prominent headlands, such as Cape Adieu, Cape Nuyts, and Point Fowler; or sunken reefs, such as Nuyts Reefs near Cape Nuyts, Yatala and Geographe Reefs opposite Fowler Bay, and many others.

Where a low foreshore occurs there are usually clear evidences of recent elevation of the land, which along the shores of the Great Bight amounts to about twelve feet above high water mark. The combined action of blown sand and coastal elevation has had the effect of converting some of the shallow shores into marginal lakes, such as Lake Macdonnell, on the eastern side of Fowler Bay; Lake Newland, parallel with Anxious Bay; and Lake Hamilton, parallel with Hall Bay. The damming back of fresh water drainage by barriers along the shore causes swamps, as in Peelunibie Swamp at the Head of the Great Bight, and Yatala Swamp on the west side of Fowler Bay. Some lakes of the coast have been reduced by evaporation to saltpans. These raised sea margins are usually indicated by shelly banks, often showing shells *in situ*, all of which are recent species, but some of them are now extinct in our local waters.

The most irregular contours of the South Australian coast are in the stretch from Fowler Bay around the headlands of Eyre Peninsula and lower end of Spencer Gulf, a distance of over 300 miles. This very tortuous coast-line has been caused by the unequal hardness of the rocks which confront the sea throughout this length of coast. In addition to the varying hardness of the recent rocks, bosses of granite and other crystalline rocks shew themselves frequently at the surface and offer still greater resistance to the action of the waves. Point Sinclair, on the east side of Fowler Bay, is the first of these granite headlands, and such outcrops become more common towards the extremity of Eyre Peninsula, where nearly all the prominent points, on this exposed coast, consist of these old and very hard rocks.

Denial and Smoky Bays, with several subordinate inlets, are at the head of a considerable indentation of the coast, in which lies Nuyts Archipelago; St. Peter Island is the breeding place of great numbers of sea birds, whilst the Isles of St. Francis are situated on the seaward side of the group.

Streaky Bay is a fine extent of sheltered water, having a prominent peninsula with a granite headland (Point Brown) at its northern limits. Here is found the only secure anchorage, in all weathers, for vessels of heavy draught, between King George Sound and Port Lincoln.

Anxious Bay is another great stretch of water, with Venus Bay, almost enclosed by land, near its head. A few miles inland, on the northern side of Anxious Bay, are several granite hills, which as inliers show their heads above the newer beds of the district. The most conspicuous of these, Mount Hall, is 638 feet high. To the south of Anxious Bay lies the Investigator Group, with Flinders Island, the most important of the group, on which sheep are pastured.

Hall Bay, situated to the south of Anxious Bay, from which it is separated by Cape Finniss, is a wide but slight indentation, with the land-locked Coffin Bay and Port Douglas, at its southern extremity. Coffin Bay is partly enclosed on its western side by a hammer-shaped peninsula, on the southern side of which is Avoid Bay and the Whidbey Isles. The land on the eastern side of Coffin Bay consists of bold exposures of granite and other crystalline rocks, which line the coast for twenty miles. Mount Greenly, in this range, is 1,000 feet high, having a strongly scarped summit from which the hill slopes down to the edge of the sea cliffs. Mount Dutton (904 feet) is at the southern end of this range, from which the Marble Range diverges in a north-eastern direction; this range has two conspicuous peaks, one at the northern end having a height of 1,421 feet; and the other, near the southern end, a height of 1,317 feet.

The southern portions of Eyre Peninsula exhibit the most broken coast line and most numerous islands of South Australia. The preservation of this great extension of the land into the Southern Ocean is due to the presence of the harder crystalline rocks, which have offered a more effectual resistance to the encroachments of the sea than the softer rocks to the west. The highlands of the older crystalline rocks, make a rock-bound coast on the western side of the Peninsula, along Coffin Bay and northward; and on the eastern side there is a similar range of old crystalline rocks, to the north of Port Lincoln, for a distance of sixty miles. All the principal headlands along the southern end of the peninsula, such as Point Sir Isaac, at the entrance to Coffin Bay; Capes Wiles, West Point, and Catastrophe, near the southern end of the Peninsula; and Cape Donington, at the entrance to Lincoln Harbour, and others, are of granite. These are the sentinels which ward off the greatest force of the sea, while the intervening softer rocks are worn back into bays and coves, as Sleaford Bay, at the extreme point of the peninsula; Port Lincoln, which is said by the Admiralty Directory to be "the finest harbour in South Australia," and Boston Bay, a little further to the north. A hard rock, like granite, may protect the land for a time, but the sea conquers in the end, as is seen by an immense number of islands and reefs in these waters, which are the silent witnesses of land swallowed up by the sea. Nearly all these islands are of granite, such as the North and South Neptunes at the entrance to Spencer Gulf, the group off Cape Catastrophe including Thistle Island, Boston Island in front of Boston Bay, the islands in Louth Bay, and the twenty islands which comprise the Sir Joseph Banks Group. These are isolated fragments, separated from the ragged fringe where the land is being torn away by the sea, and, whilst possessing a base of crystalline rocks, the islands are still covered with indurated wind-blown sands, (in some cases hundreds of feet thick) which give evidence of their former connection with the mainland.

Inspection of a map shows that Spencer and St. Vincent Gulfs form together a great triangular extension of the sea, running up into the land, with Yorke Peninsula, as a nearly central ridge of land dividing it into two parts. These inlets represent the submerged portions of the Great Valley of South Australia. Spencer Gulf is navigable as far as Port Augusta, a distance of 180 miles from the entrance of the Gulf. In its middle and upper portions the shore line is mostly low, consisting of recently raised marine flats and mangrove swamps. Franklin Harbour, about midway on its western coast, is a large sheet of water nearly surrounded by land and so shallow as to be mostly dry at low tides. At Port Augusta the Gulf is only a quarter of a mile wide, but has deep water. North of this port the Gulf shallows rapidly and at six miles higher up is dry at low water. The valley indicated by the Gulf, goes much further, however, than the present limits, and a low marshy track, with a gradient of about one in two thousand, unites the head of the Gulf with Lake Torrens.

The physical features at the head of Spencer Gulf are instructive. On either side of the Gulf are coastal plains, twelve or more miles in breadth, bounded by high ranges of hills. The Flinders Ranges, which rise abruptly from the plain, close the view to the east, with Mount Brown, the highest point, reaching 3,174 feet. This hill was named by Flinders, after a naturalist of that name, on board the *Investigator*, who with several companions from the ship, walked fifteen miles to its base, slept on the mountain, and from its summit took in with admiration the great panoramic view of hills which stretched away to the north-east. On the western side of the Gulf, the flat-topped Tent Hills and the Lincoln Gap Ranges converge to the shore a few miles below Port Augusta. It was at the head of this Gulf that Flinders met his great disappointment, a wide valley, bordered by high hills on either side, but no great waterway, such as he had hoped to find, opening the way to the unknown interior. There are evidences, however, that at one time an important river entered the head of Spencer Gulf, but the drainage has been diverted into other channels by certain earth-movements, that will be explained in a later chapter. (See pp. 124-5).

On the eastern side of Spencer Gulf, south of Port Augusta, the coastal plain continues as a well defined strip between the Flinders Ranges and the sea as far as Port Pirie, south of which it becomes wider and less defined, with the Barunga Ranges and the Hummocks on its eastern limits, the latter ending at the head of St. Vincent Gulf. Several important harbours occur on the eastern coast of Spencer Gulf—in addition to Port Augusta there are Port Germein which exports wheat, Port Pirie which smelts and exports minerals, Port Broughton, and Port Wallaroo.

Kangaroo Island, which protects the southern end of St. Vincent Gulf, is 80 miles long and 24 miles broad, and is the island second in size in the Australian system. The northern coast between Cape Borda and Point Marsden, consists mainly of steep, bold cliffs of older rocks, sometimes capped by limestones and blown sand. The north-eastern portion of the island is more or less covered with an old glacial clay, which is often seen in the cliffs of the coast, containing ice-scratched erratics, and in places strews the beach with ice-travelled stones weighing many tons. This glacial clay forms the best agricultural land on the island. Cape Borda, at the north-western point of the island, has a perpendicular cliff, 200 feet in height (on which is built the most important lighthouse in South Australia) with hills rising to 500 feet behind the cliffs. The western and southern coasts of Kangaroo Island consist largely of sand hills, often consolidated into sand-rock, with prominent headlands of granite or other crystalline rocks. There is thus a close resemblance in the physical features of the southern coast of Kangaroo Island and the southern coast of the mainland. In places there are great belts of blown sand bordering the coast, as at Cape Gantheaume, a headland of crystalline rock, 150 feet high, at the back of which the blown sand covers a belt nine miles wide, and at the Brecknells, further to the west, one-and-a-half miles wide. Some of these sand dunes are more than 300 feet high and perfectly destitute of any vegetation. This great waste, heaped up by the sea and wind, is vastly more extensive than the present limited coast line could produce, and probably represents the spoil of continental land now submerged in the Southern Ocean.

The eastern side of Kangaroo Island has a very irregular outline, with lower cliffs, shallower sea, and sandy bays. The great feature of this side of the island is the Dudley Peninsula, joined to the larger mass by a low narrow neck less than a mile in width. Cape Willoughby (on which is the lighthouse for Backstairs Passage), is a bold granite headland, 173 feet high, and forms the extreme eastern limit of the island. D'Estrée and Pennington Bay, on the southern side; Antechamber Bay, on the east; and

Eastern Cove, Nepean Bay, and Bay of Shoals, on the north, all offer sheltered retreats for shipping in most states of the weather. Between Antechamber Bay and Hog Bay Point, the cliffs consist of old rocks, bold and almost inaccessible; but along the low littoral of Antechamber Bay, Pelican Lagoon, the Neck or isthmus, Western Cove, in Nepean Bay, and the Bay of Shoals, there are abundant evidences of the recent elevation of the land above high water mark. Banks of recent shells extend back from the coast, in places, more than a mile and at elevations up to 20 feet above present sea level. It is clear that the Dudley Peninsula was at a recent date entirely surrounded by water.

Investigator Strait and St. Vincent Gulf together form a right-angled indentation of the coast. With the exception of the south-eastern portions, from Cape Borda and Cape Jervis to within a few miles of Adelaide (in which the cliffs are of old rocks and often bold), the shores of St. Vincent Gulf are generally low and sandy, with a fringe of raised beach, often resting on Kainozoic limestones.

A shallow estuarine area, which formerly received the waters of the Rivers Torrens and Sturt, is now partially above sea level, with an inner line of sand hills extending from Glenelg, on the coast, to Dry Creek, six miles from the sea. The Patawalonga Creek, the Port Adelaide Creek, and the North Arm, are the remains of this old estuary; whilst Lefevre Peninsula, seven miles in length, represents the barrier which was created incidental to the elevation of the land by which the sea has been more effectually excluded and the drainage of the land prevented from reaching

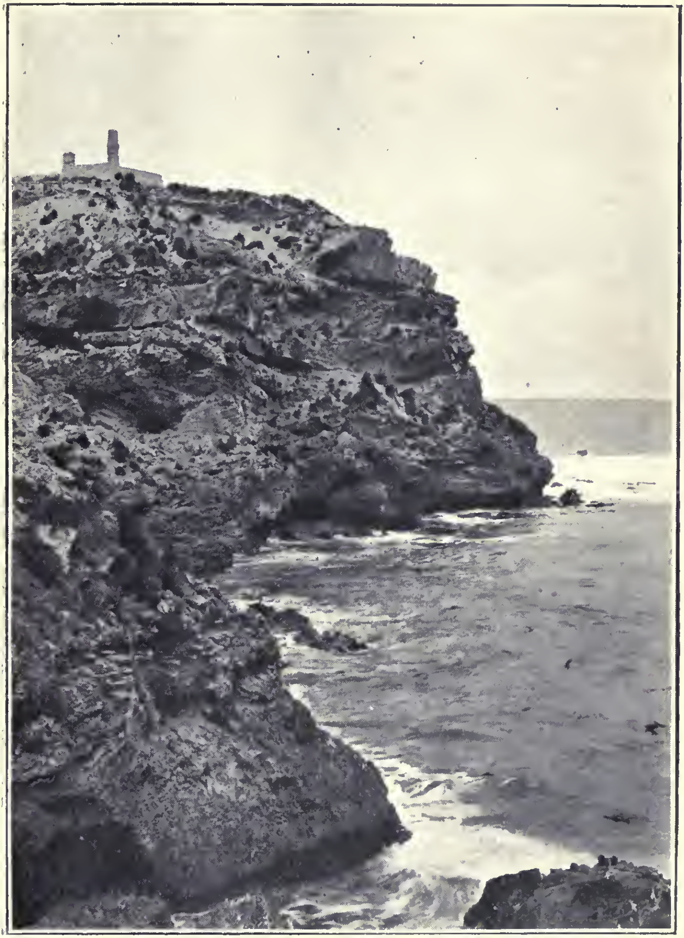

Photo. Com. of S.A. Rlys

Fig. 27. Cape Northumberland, consisting of consolidated wind-blown sand.

the sea. The elevation of the coast in the Gulf has been about twelve feet, and the land thus raised continues in low flats and mangrove swamps to the head of the Gulf. Port Adelaide and Port Wakefield are built on raised beaches.

In Backstairs Passage, the Three Pages, as granite islands, form the connecting link between the granite of Cape Willoughby and that of Rosetta Head and of several islands on the western side of Encounter Bay. At Commodore Point, Port Elliot, and a few low reefs at Middleton, the old rocks disappear, and from this latter point to the Victorian border, the coast line is relatively low, sandy, and of uniform character.

On the eastern side of Encounter Bay the Murray River, after flowing through Lake Alexandrina, finds its outlet by a narrow channel through sandhills, with a depth of twelve feet at high water. Connected with the same outlet is the remarkable marginal inlet of the Coorong. This has a width of from one to two miles, and runs parallel with the coast for a distance of 90 miles, with a barrier of sandhills between it and the sea.

In Lacepede Bay there are a few low exposures of granite, otherwise the whole coast line from the mouth of the River Murray to the Victorian Border, and the country for many miles inland (with the exception of scattered humps of granite), consist of a recently elevated coastal plain. The cemented calcareous sands, mostly wind-blown, sometimes form fantastic and serrated cliffs and low ranges, like that of Mount Benson, parallel to the coast. A good example of these recently formed æolian or wind-blown sands is seen in the bold headlands of Cape Northumberland. (Fig. 27.)

CHAPTER II.—THE MOUNTAINS OF SOUTH AUSTRALIA.

The land-forms of South Australia may be roughly regarded as consisting of vast undulating plains and plateaus, with a great central belt of hill country, running north and south from Cape Jervis to Lake Eyre, a distance of nearly 500 miles. There are, however, remains of older highlands, which have had a distinct origin from the present central ranges, and must at one time have rivalled the latter in elevation and extent. The two classes of mountains are strongly contrasted in their age, direction, structure, and physical features.

A. THE OLDER SYSTEM—MOUNTAINS TRENDING EAST AND WEST.

The mountains of this class represent the primitive or most ancient physical geography of South Australia. The rocks of which they are composed belong to the oldest portions of the crust of the earth that come under our observation, and have been exposed to the agents of waste for such a vast period of time that they are now worn down to a mere fraction of their former size. This can be inferred from the fact that these hills and mountains consist mainly of granitic rocks, which form only at great depths along the axes of elevation. It is, therefore, only when a large amount of material has been removed from a mountain range, and the central core is exposed, that the granite can be seen at the surface. These very old rocks are distinguished by the name Archæan and contain no evidence of organic remains.

The larger portions of these primitive highlands have been reduced to plateaus or are buried to a greater or less extent under deposits of more recent date. The most important fragments of these very old mountains are seen in the MacDonnell Ranges, the Musgrave Ranges, and the Everard Ranges, all of which, together with the subordinate members of the same age, have an east and west trend.

Limiting our study in mountains of this class to South Australia proper, we have the most prominent heights near the north-western boundary of South Australia and the Northern Territory in two groups of ranges which, at a distance apart of about sixty miles, present fairly parallel courses and extend from the great cretaceous basin on the east, to the Western Australian borders on the west.

Of the more northerly group, the **Musgrave Ranges** are the most prominent members. They have an eastern and western extension of about 100 miles and a breadth of 20 miles. They consist of granitic rocks and are broken up into isolated mountains separated by narrow plains or low passes. Mounts Ferdinand and Cuthbert are each about 3,600 feet above sea level, and Mount Woodroffe, the highest peak, 5,200 feet, and rises 2,400 feet above the surrounding plain. These, like most of the desert hills, are largely submerged by drift sand around their bases and along their flanks, the sand having choked, to a considerable height, the old water-courses by which the ranges were formerly drained. A great number of isolated granite knolls, which rise above the sandy plain, must be regarded as outlying fragments of the Musgrave Ranges. On the eastern side, a group of these fragments, which in the main are on the Northern Territory side of the boundary, are known as the **Ayers Ranges**. The **Anthony Range**, at a still further distance to the east, is on the edge of the great cretaceous basin of Lake Eyre. While these hills often attain a height of over 2,000 feet above sea level, they do not rise more than from 100 to 300 feet above the sands at their base. On the western side of the Musgraves are the **Mann** and **Tomkinson Ranges**, the latter crossing the border into Western Australia. These ranges are similar in all respects to the Musgraves but do not reach so great an elevation.

The **Everard Ranges** form the leading feature of the southern group in this northern system of mountains. They are situated about 60 miles to the south-east of the Musgraves and have a length of 50 miles, with Mount Illbillie, 3,010 feet above sea level, as their highest point. In the same belt of highlands, to the west of the Everard Ranges, are the **Birksgate** and the **Blythe Ranges**, the latter on the Western Australian boundary. All these ranges consist mainly of granite, sometimes penetrated by igneous dykes, and are bordered on their southern limits with highly metamorphosed sedimentary beds of lower Palæozoic age.

A long way to the south of the above groups, in the neighbourhood of Lake Gairdner, is another extensive belt of igneous rocks, comprehended under the general name of the **Gawler Ranges**, the general elevation of which varies up to 500 feet. These are rounded hills rising from an extended plateau which is between 800 and 900 feet above sea level. The hills occur as isolated fragments, separated by flats of reddish loam derived from the waste of the igneous rocks. The Gawler Ranges extend for 100 miles, east and west, and are about the same in breadth, and form the borders of Lake Gairdner on its south and west shores. To the north-west, are the **Warburton Ranges**, including Wilgena Hill, Partridge Range, and the Tarcoola Goldfields.

There are evidences which show that in the very remote period to which the Archæan rocks belong, there were great mountain ranges in South Australia which have not only been worn down to a level, but have been submerged by the sea. Yorke Peninsula forms the base of one of these old mountain ranges. This once great range of hills has disappeared long since, for the base of these old mountains was no more than a sunken reef in the Cambrian (lower Palæozoic) seas. The great valley of the Murray, including the Olary district and the eastern side of the Flinders Ranges, passing into New South Wales, was the site of another great range, which probably in its time was one of the main watersheds of the country. Another axis of elevation had an east and west direction to the south of Kangaroo Island (Fig. 28), and formed a watershed which threw the drainage of the southern highlands into a sea which existed to the north; but all that great range of mountains is gone and its foundations are now under the Southern Sea.

The vast quantity of material which was worn down from these primitive highlands went to form the newer system of mountains that now form the most important axes of elevation in South Australia, as the Mount Lofty and other ranges.

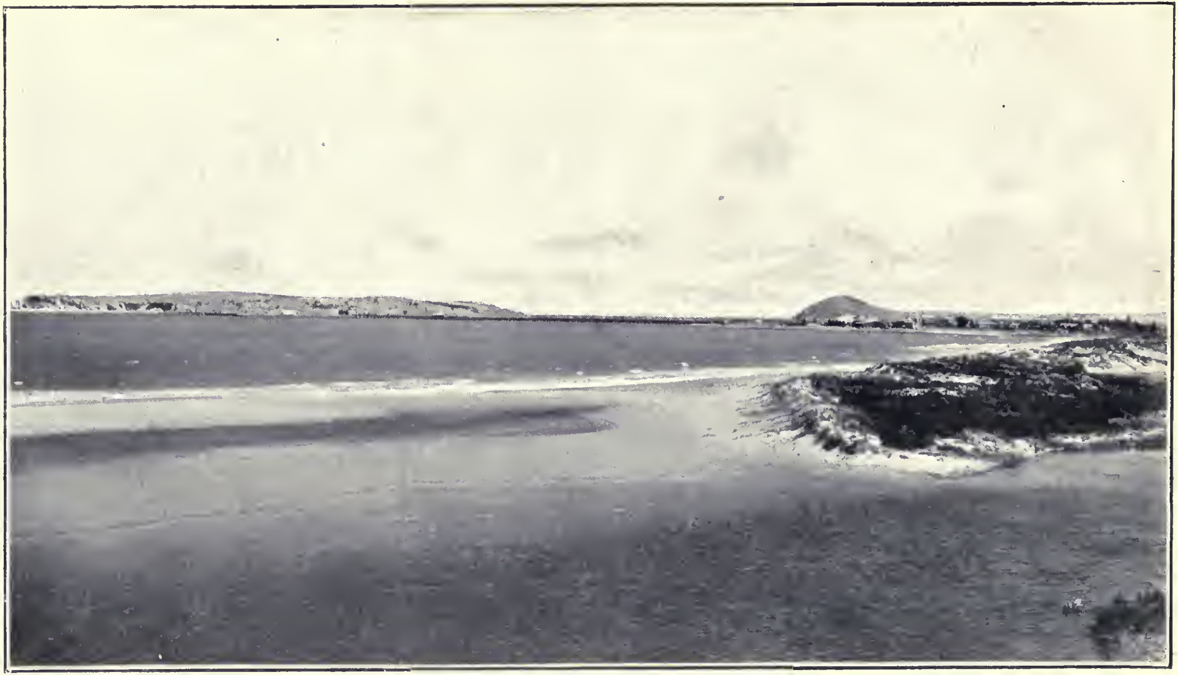

Photo. Com. of S.A. Rlys.

Fig. 28. Rosetta Head (The Bluff) and Granite Island, in Encounter Bay: fragments of the old granite Ranges which once formed the watershed on the south side of South Australia.

B. The Newer System—Mountains Trending North and South.

The most striking orographical feature of South Australia, in its present stage of physical evolution, consists of a wide belt of highlands which runs from Kangaroo Island and Cape Jervis in the south, to the latitude of Lake Eyre in the north. The ranges which form these highlands have, roughly, a north and south direction and lie in a great trough of the Archæan rocks, which form their eastern and western boundaries, and have been greatly lowered by denudation. This mountain system although much newer than the older system already dealt with, is, notwithstanding, of great age, as the rocks of which it is composed belong to a period (Cambrian) which contains the earliest distinct evidences of life on the earth. These highlands are split up into numerous local ranges, which in places reach an elevation of over 3,000 feet. The ranges are usually separated from each other by undulating or nearly level plains, and as a result of these longitudinal valleys, the northern railway has been carried through the hill country, reaching an elevation near Petersburg of over 2,000 feet, without the necessity of cutting a single tunnel.

The various so-called "ranges," into which the central highlands have been divided by geographical names, are purely conventional, as they form a geographical unit. The same rocks, maintaining similar geological characteristics, can be traced from their southern to their northern limits. Whilst there is this geological continuity in the hills which form the backbone of the country, they exhibit a marked contrast in outline between their northern and

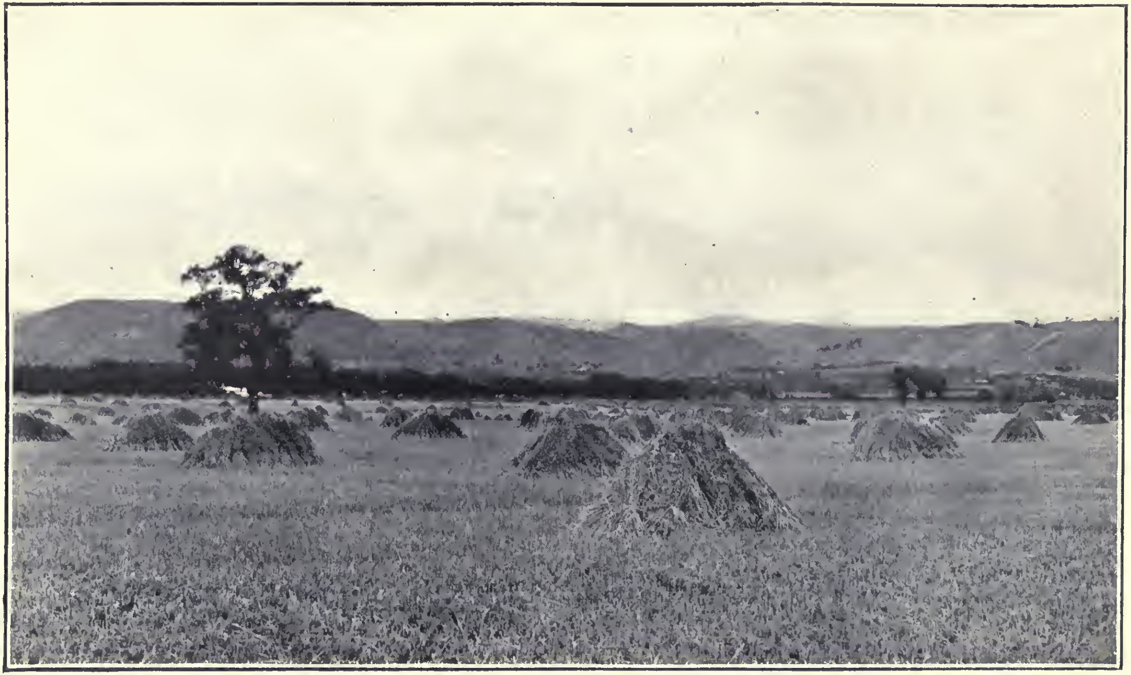

Photo. Surveyor-General's Dept.

Fig, 29, Foot-hills of the Mount Lofty Ranges, as seen from Adelaide three miles distant.

southern features. In the southern, moist climate, the hills are rounded and thickly wooded; whilst in the northern Flinders Ranges they are mostly bare of vegetation, possessing precipitous, rugged, and deeply serrated outlines which give evidence of the arid character of the climate.

It will be convenient to consider this Newer System of mountain ranges in five sections:— (*a*) the southern, (*b*) the middle, (*c*) the northern, (*d*) the far northern, (*e*) the western.

(*a*) **The Southern Portion** includes a number of parallel ranges extending from Cape Jervis to Gawler. These are often grouped under the general designation of the **Mount Lofty Ranges.** Kangaroo Island, which properly forms the extreme south-western extension of this geological belt of country, has no prominent heights. The ranges are contracted to a narrow breadth in the Cape Jervis Peninsula and gradually widen out as they go northward. The principal ridges in this section are as follows:—The **Sellick's Hill** and **Willunga Ranges,** with Mount Terrible, Mount Panorama, and Mount Bold. This range passes northward into the **Mount Lofty Ranges** proper, with Mount Lofty (2,334 ft.) the highest point in the southern section of hills. (Figs. 29 and 30.) **Forest Range** and **Mount Gould Range** are on the eastern side of Mount Lofty; and in a parallel position, still further east, is the **Bull's Creek Range,** with Mount Compass and Mount Magnificent; and in its northern extension it passes into the **Mount Torrens Range,** with Mount Charles and Mount Torrens. **Mount Barker** is a conspicuous, isolated height; and the **Bremer Range,** on the eastern bank of the Bremer

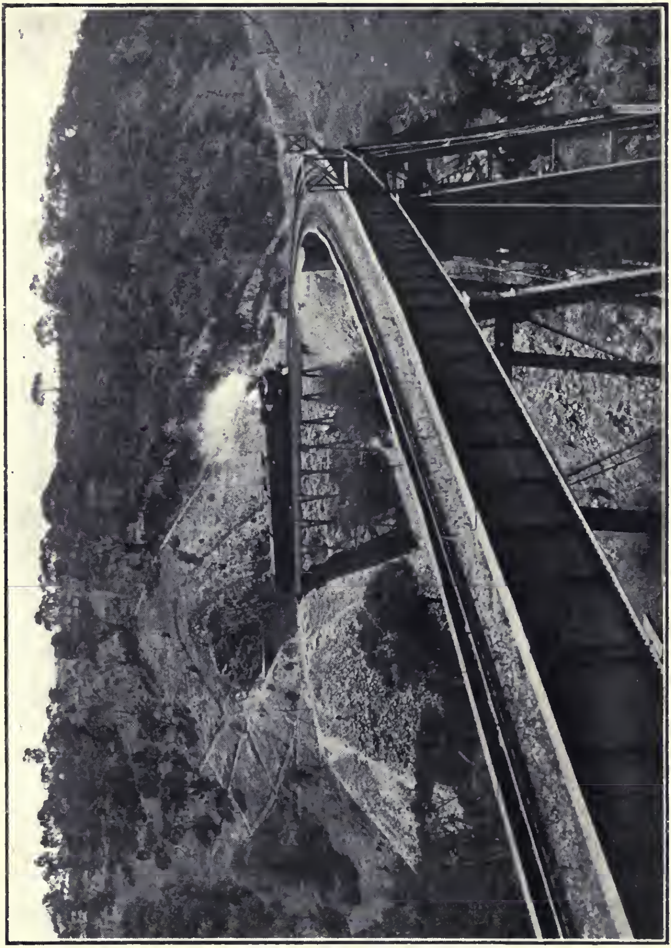

Photo. Com. of S.A. Rlys.

Fig. 30. Scene on Mount Lofty Ranges on the Adelaide and Melbourne Railway.

River, overlooks the Murray Flats. The Mount Lofty Ranges have been so crushed and folded by lateral compression that the beds which were laid down in a horizontal position are now often standing on end, as is seen in Fig. 31.

(*b*) **The Middle Section.**—Towards Gawler the western side of the ranges passes into a plateau, covered by auriferous sands and gravels, deeply cut by water-courses. From this elevated plateau, on its eastern side, rise the **Barossa Ranges**, with Mount Crawford and the Kaiserstuhl. The **Hummocks** and **Barunga Ranges** extend from the head of St. Vincent Gulf to Crystal Brook. East of Kapunda is the **Murray Range**. In the neighbourhood of the Burra are the **Camel's Hump, Brown's Hill,** and **Bald Hill Ranges,** including Mount Cone (2,601 feet) Razorback (2,834 feet), Mount Bryan (3,065 feet), and Ulooloo Hill. Around Petersburg and Jamestown an elevated plateau, or peneplain, takes the place of the ranges, with an average altitude of 1,500 to 2,000 feet. Belalie North, situated between the two towns just named, is the highest point (2,026 feet) on the South Australian railways. Between Petersburg and the New South Wales borders, the hills rise abruptly from the elevated plain, up to 500-600 feet, forming low ranges.

The **Flinders Ranges**, taken as a whole, are comprised in an area that forms roughly an acute isosceles triangle, with its apex at Crystal Brook and its base between Lake Eyre and north of Lake Frome. The **Southern Flinders,** which are most conveniently included in the middlesection of highlands, commence at Crystal Brook, and extend to Quorn and Port

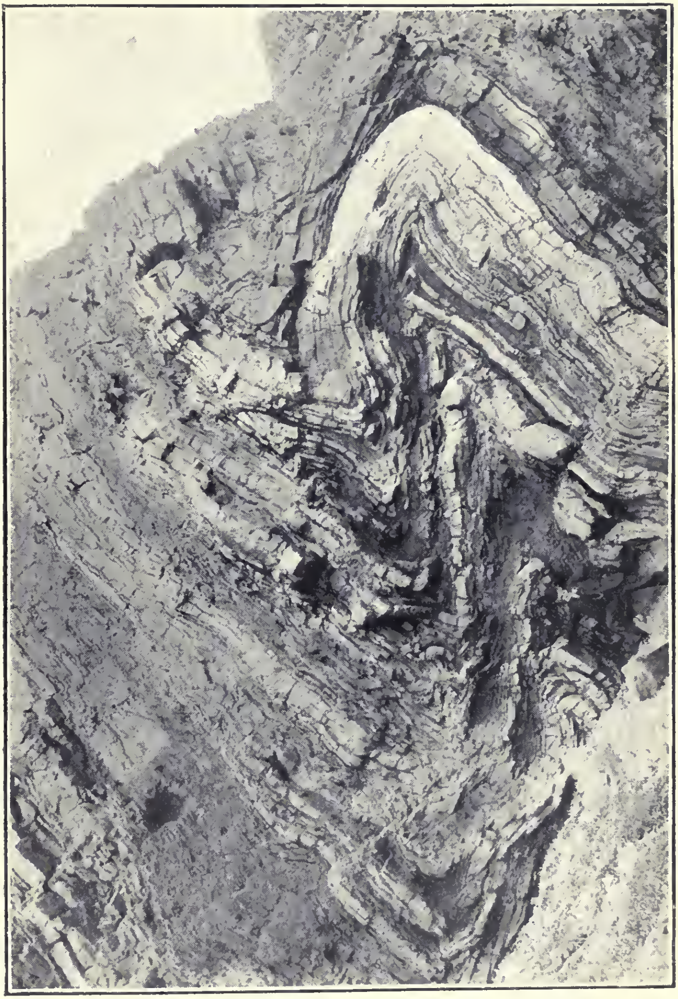

Fig. 31. Crushed and Contorted Rocks of the Mount Lofty Ranges.

Photo. J. Greenlees.

Augusta. They exhibit a very precipitous face towards the Gulf and are divided into numerous parallel ranges, sometimes separated by broad and level alluvial plains. The principal heights in this section are the **Mount Remarkable Range** (3,178 feet), and the **Black Range,** bordering the Gulf. The Gorge (Back Creek), and Horrock's Pass, penetrate the last named range, and exhibit very fine rock scenery.

(*c.*) **The Northern Section** extends from Quorn to the southern margins of Lake Eyre Basin. The greater portion of these highlands are comprehended in the **Northern Flinders** and includes the roughest and most inaccessible portions of the highlands of South Australia. Mount Brown (ascended by a party from Flinders's ship), is 3,174 feet; and Devil's Peak, a rugged summit nearly equal in height, are situated between Quorn and Port Augusta. The railway, uniting these places, passes through the Pichi-richi Pass at an elevation of 1,335 feet. To the north of Quorn are Mockra Tower, Mount Arden, Mount Benjamin, and Mount Ragless. To the west of Hawker is the **Yappala Range,** and to the north of that township, **Elder Range,** which includes the remarkable Wilpena Pound, a vast mountain amphitheatre, eleven miles by three miles, which can be entered only by a deep and narrow gorge at one point.

The northern railway runs parallel with Lake Torrens over a level plain, with a bold escarpment of hills, parallel with the track, on its eastern side. These hills which present steep inaccessible faces and jagged peaks to the west, probably represent a fault

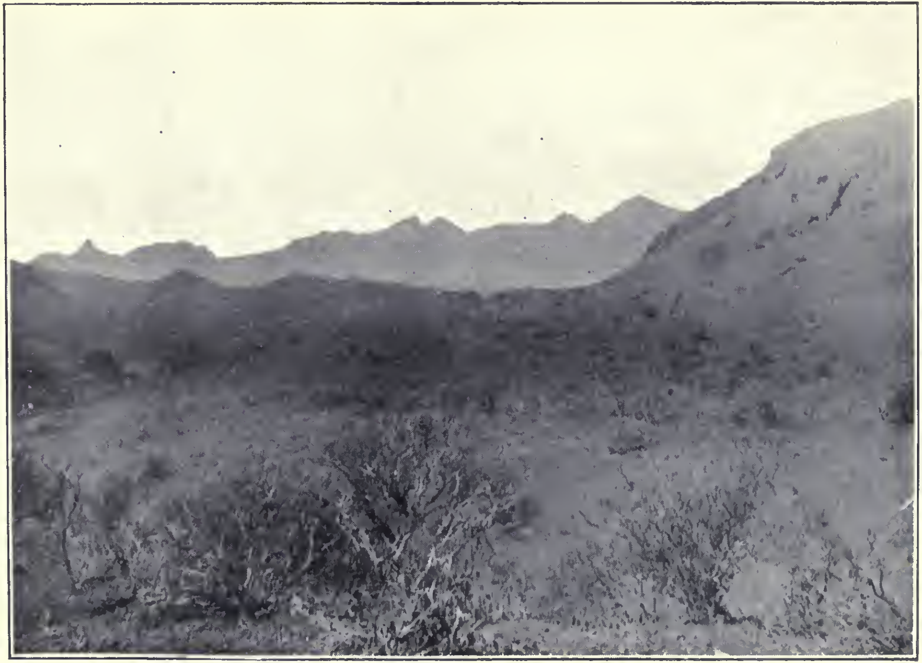

Photo. W. B. Greenwood.

Fig. 32. View of the Flinders Ranges, North East of Yudanamutana, shewing the sharp, angular weathering of hills in dry regions.

scarp connected with the great central valley of South Australia. This wall of rock is cut by the Parachilna Pass which gives access to the east.

The northern part of the Flinders forms the watershed between Lake Eyre and Lake Frome. Mounts Serle, McKinlay, Rose, Axis, Lyndhurst, the Freeling Heights (3,120 feet), Fitton, and Babbage, are amongst the most prominent elevations. The hills are generally precipitous and bare of vegetation, with sharp angular outlines characteristic of desert weathering, as seen in Fig. 32. Mountain torrents have cut deep gorges, which find their outlets in stony watercourses that are dry except after heavy rains.

A branch of the Flinders Ranges, commencing near Beltana, strikes north-west, and includes Mounts James, Deception, Scott, and Termination Hill. In the angle formed by the railway at Hergott Springs, on the west side of the line, are the **Willouran** and the **Hermit Ranges**, with Mount Nor'-West in the latter.

(*d*) **The Far-North Section.**—North of Hergott Springs, the older rocks, with the exception of a few isolated outcrops on the west side, pass from sight under the newer deposits of the Lake Eyre Basin. The **Denison Ranges,** forty miles in length by twelve in breadth, with an elevation of 1,000 feet above the sea, form an isolated group from Anna Creek to Bull Dog Creek. The railway skirts the western flanks. The **Peake Range** (Fig. 33) rises a few miles to the north of the Denison, with which it has the same lineal direction.

In the fork produced by the junction of the Indulkana Creek and Alberga River, there is a broad tableland of rocks of similar age to those already

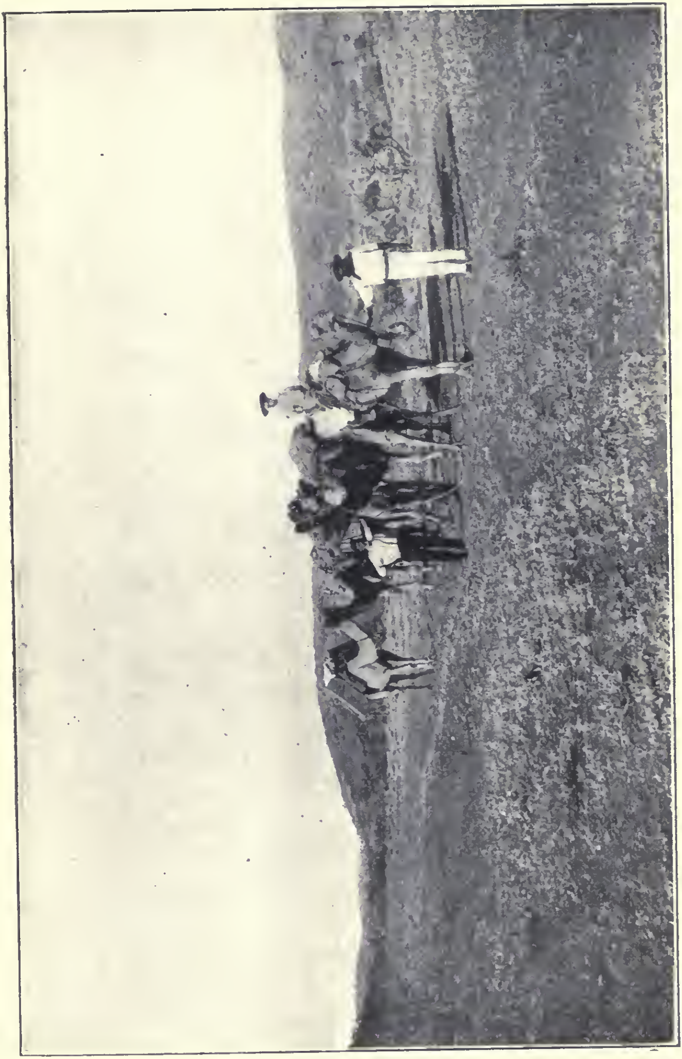

Fig. 33. A Camel Team crossing the Peake Ranges, West of Lake Eyre. (From *The Dead Heart of Australia*.)

mentioned, with Mounts Mystery, Johns, Chandler, and others.

(*e.*) **The Western Section.**—On Eyre's Peninsula an isolated group occurs to the north of Port Lincoln, with Mount Hill, 1,600 feet; and another to the west of Franklin Harbour, with Mount Olinthus, 2,000 feet. The Coffin Bay and Marble Ranges, on the west side of Eyre Peninsula, which attain an elevation of over 1,400 feet, include Mount Greenly (1,000 feet), and Mount Dutton, 904 feet.

CHAPTER III.—THE LOWLANDS.

The lowlands of South Australia, including the plateaus and tablelands of moderate elevation, form, by far, the greater part of its surface. These can be referred to five great areas:—1. The Western Plateau; 2. The Lake Eyre Basin, including the tablelands of the Desert Sandstone; 3. The Great Valley formed by the Gulfs and Lake Torrens, with the adjacent plains; 4. The Lake Frome Basin; 5. The south-eastern basin as far as the Victorian borders.

A.—PLATEAUS AND TABLELANDS.

The western half of South Australia forms part of the great plateau country which extends far into Western Australia. The country bordering the sea cliffs at the head of the Great Australian Bight, has been called the **Bunda Plateau,** from the native name for these cliffs; and, from its treeless character, has also been called the **Nullarbor Plains.** Although to the eye these plains appear to be level, there is a very gradual gradient from the sea cliffs, which are 250 feet high, towards the interior, the average height of the plateau being estimated at from 800 to 1,000 feet above sea level. In places, sandhills and hummocks of the older rocks rise above the plain to the height of several hundred feet. On the inland side it includes the eastern extension of the Great Victorian Desert. and passes northward into the central regions. It is destitute of rivers or running water.

A second plateau, or tableland, of more limited extent, occurs on the western side of Lake Torrens, and may be designated the **Lake Torrens Plateau.** Isolated fragments are found from Point Lowly, on Spencer Gulf; passing northwards, it includes the Tent Hills, near Port Augusta, and attains its greatest width between Lake Torrens and Island Lagoon. This plateau consists of rocks of the same age as the Flinders Ranges, and forms the western edge of these beds. They are therefore much older than the marine (Kainozoic) limestones of the Bunda Plateau; but much younger than the primitive rocks, which form the worn-down eastern and western ranges of stunted hills on the great western plateau. These beds form flat topped hills because they have not been subjected to foldings of the earth's crust. The tableland is dissected by numerous ravines and watercourses, and often shows scarped cliffs, as at Euro Bluff and Dutton Bluff.

A third, and newer tableland than the last described, once extended over most of central and northern Australia, and is known as the **Desert Sandstone Tableland.** It represents the old land and fresh water deposits which accumulated after the Cretaceous sea drained off from Central Australia. The regular flat-topped hills represent the old land levels, fragments of which have been preserved from denudation by hard silicious beds, that have formed protecting cappings for the softer beds beneath. They form the general feature of the western side of Lake Eyre and extend from Leigh Creek in the south, with some breaks, to the northern coast of Australia. (Fig. 34.)

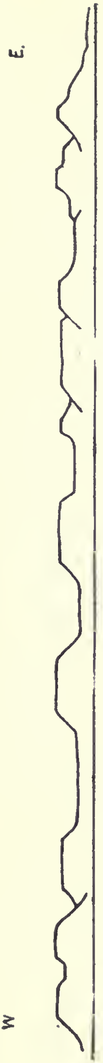

Fig. 34. Outline of Table-top Hills (Desert Sandstone Plateau) on west side of Stuart Creek Cattle Station.

The **Piedmont Plateau** skirts the western sides of the Barossa and Mount Lofty Ranges, forming foot-hills at an average height of about 500-600 feet. It is well marked in the Barossa Gold Field, and in the Mitcham, Blackwood, and O'Halloran Hill plateau, which continues south to the Onkaparinga River. It is characterised by deposits of soft sandstones and small gravel, that were laid down by the older river systems that had a north and south direction, and which at times, as at Highbury and Anstey Hill, near Adelaide, reach a thickness of 200 feet.

B.—Plains.

The plains of South Australia may be classed under three headings in relation to their origin: (*a*) **Coastal Plains**—recovered from the sea by natural elevation of the land, (*b*) **Flood Plains**—caused by river deposits or rain wash, (*c*) **Pene-**

plains—uplands which have been reduced by denudation to gentle undulations of the surface.

(*a*) **Coastal Plains.**—The plains which form the greater part of the maritime districts of South Australia owe their existence to encroachments of the sea during Kainozoic and Recent times, followed by an elevation of the land. These marginal deposits vary in altitude from below sea level to a height of about 300 feet; and were laid down, not in one earth movement, but during a succession of depressions and elevations of the coasts. These coastal plains generally have a greater or less deposit of alluvial wash as a surface cover.

The **Adelaide and Port Wakefield Plain** extends from Brighton, nine miles south of Adelaide, to the head of St. Vincent Gulf, and is bounded on the east by the Mount Lofty and other ranges. In the neighbourhood of Adelaide, in Kainozoic times, the sea reached the base of the hills. The **Wallaroo, Broughton,** and **Pirie Plain,** is on the eastern side of Spencer Gulf. The **Flinders,** or **Port Germein Plain,** is between the Southern Flinders Ranges and the sea.

The greatest development of coastal plains in South Australia is in the south-east, between the central highlands and the Victorian border. It is often spoken of in three sections: the **Murray Flats,** between the ranges and the River Murray; the **Ninety-Mile "Desert"** (or Plain) between the River and the Victorian border by the old stock routes; and the **South East,** or most southerly section. The physical features throughout are very uniform. Gently undulating ground, with a few more prominent ridges; light, sandy soil, which frequently changes to a travertine-limestone crust;

and a dense cover of stunted scrub, chiefly Eucalypti, several varieties of which are classed under the general name of "mallee." The Murray Flats have been largely cleared for wheat. The so-called Ninety-Mile "Desert" not only supports sheep but is gradually being brought under cultivation. A railway recently opened to Pinnaroo, on its eastern side, has greatly promoted settlement. The volcanic ash soils around Mount Gambier make that district the richest garden in the State, three crops being obtained from the same ground in a year. The country east of the Murray has been subjected to great oscillations of level within recent geological times. There has been a recent elevation up to 200 feet over thousands of square miles on the seaward side, and these recent beds are bordered and underlain by the Kainozoic limestone, which from its porous nature becomes the main water stratum of the district. Caves frequently occur in this limestone, sometimes, as in the case of the Blanche Caves, near Naracoorte, exhibiting a beautiful display of stalactites and travertine drapery. (Fig. 35.) Where the subsoil is retentive, swamps are formed; as Carey Swamp, west of Naracoorte; and the Dismal Swamp, in the Hundreds of Mingbool and Young, north of Mount Gambier. The water from these swamps often escapes by "run-away holes" in the limestone. The clay and marly flats between the sand ridges are usually swampy, and in the winter may become channels of water. Drains have been cut in some directions and the swampy land brought under cultivation.

(*b*) **Flood Plains.**—The rivers of a country which possesses a regular and moderate rainfall, cut for themselves well defined channels, and, except in

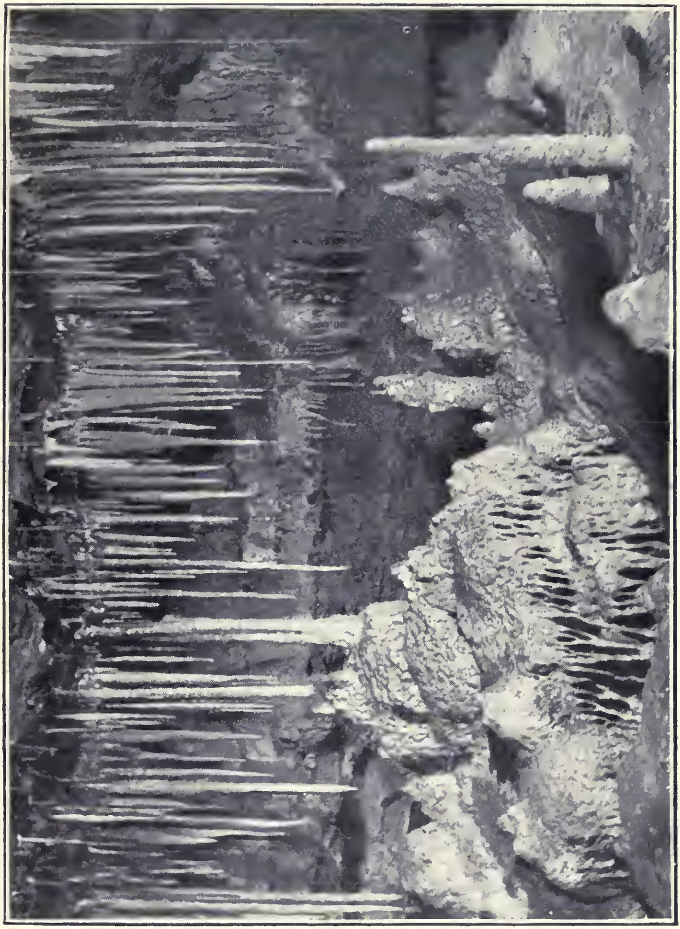

Fig. 35. View in the Victoria Cave, Naracoorte.

Photo Com. of S.A. Rlys.

low-lying districts, rarely overflow their banks. On the other hand, where the rainfall is uncertain and often torrential in character, the drainage lines are usually shallow, broad and irregular. In such cases the alluvial wash is often spread laterally, as fans, over a great extent of ground. In this way alluvial plains have been formed between the ranges in South Australia, with local creeks, which only run in flood times and then often spread out a mile wide, covering the cultivated ground. Near Adelaide (Croydon), the alluvial wash, forming the plain, is nearly 400 feet thick. Plains of this origin form some of the best agricultural land of the State, such as the **Gawler Plains, Booleroo Plain, Farrell Flat, Black Rock Plain**, etc. The **Willochra Plain** is a wide flat, extending for 100 miles from Melrose to Lake Torrens, subject to inundation by the Willochra Creek.

Extensive flood plains occur in the Lake Eyre Basin, laid down by the Strzelecki, Cooper, Diamantina and other creeks, which in flood, may be ten or twelve miles wide.

(*c*) **Peneplains.**—South Australia has been subjected to atmospheric waste for so vast a period of time that its former mountains have been reduced to small dimensions, and for the most part to undulating plains. It is only the harder portions of these old highlands which now stand up as prominent ridges. Most of the high ground of South Australia forms a succession of rounded knolls and saddle-backs, with a good cover of strong productive soil. Country of this character forms some of the best agricultural lands in South Australia, from Adelaide to Quorn and along the eastern gradients of the Mount Lofty Ranges. These ranges as a whole, might be regarded as an old peneplain, dissected by gorges and valleys that have been excavated by means of running water. The agricultural areas of the lower north, from Gawler to Petersburg, and thence west to Crystal Brook, may be taken as typical illustrations of a peneplain. Yorke Peninsula and Kangaroo Island represent peneplains of the older mountain system more or less covered by newer deposits.

CHAPTER IV.—BASINS AND LAKES.

A.—BASINS.

Basins are of two kinds. 1. Those that receive inland drainage and have no outlet to the sea. Basins of this class form salt lakes, because they cannot get rid of the mineral matter dissolved in the water.

2. Those that contain river systems of drainage that have an outlet to the sea. The constant flow of water to the sea removes the soluble minerals derived from the land and thus the waters are kept always fresh. The Murray Basin belongs to this latter type, but will be dealt with under the River Systems.

Central Australia is remarkable for the number of **inland basins** which it contains. These may be divided into seven groups: (1) The central basin of Lake Eyre. (2) The eastern group of which Lake Frome is the most important. (3) Lake Woods in the north and (4) Lake Amadeus in the west, are in the Northern Territory. (5) The south-western group of Lake Gairdner, etc. (6) Lake Torrens. (7) Belonging to a different class, is the Murray Basin, which is a basin open to the sea.

(*a*.) **The Lake Eyre Basin** is the most striking feature of Central Australia. If we include with it groups 2, 3, 4, which may well be regarded as secondaries of the great basin, it has an area greater than that drained by the Murray. The deepest part of the basin is near its south western limits and forms Lake Eyre. The outline of the lake is in places somewhat undefined as the margin consists of extensive mud flats, which near the water's edge, are so soft as to be impassable and the water is too shallow for a boat. From these difficulties the centre of Lake Eyre has not yet been explored. The lake is divided into Lake Eyre North, which is ninety miles north and south, and about fifty miles east and west; and Lake Eyre South, which is fifteen miles north and south and forty miles east and west. The two lakes are connected by a narrow channel ten miles in length. If the two lakes were full of water they would cover 5,000 square miles. At Stuart Creek Railway Station the line crosses the edge of this basin close to Lake Eyre South, and is three feet below sea level. The water at times comes within a mile of the railway and is then 39 feet below sea level, whilst at the centre of Lake Eyre North, it is estimated that the bottom of the lake may be 60 feet below sea level.

The drainage area of Lake Eyre basin is closed to the south by the Flinders and Willouran Ranges, and by the low ridge between Lake Eyre and Lake Torrens, which, at its lowest point, is 175 feet above sea level. On the east it extends to the great Dividing

Range of Queensland. The northern limits are found in the MacDonnell and Hart Ranges and the tableland to the north of Tennants Creek, including Newcastle Waters and Lake Woods. On the western side, the basin is limited by the great western plateau and the Everard and Musgrave Ranges. Its greatest length may be taken at about the 137th meridian of east longitude, and measures 750 miles; and its greatest breadth, at the 24th parallel of south latitude, at 900 miles, with an area roughly estimated at 500,000 square miles.

The Lake Eyre basin owes its existence to earth movements on a large scale, which, in their beginning, date from a remote age. The opinion held by some of the early explorers that this vast area of low-lying, sandy country, was a basin from which the sea had but recently retired, was incorrect. At the somewhat remote time, however, when the chalk beds (Cretaceous) were being laid down in a sea that covered much of southern Europe, there was a great sea or land-locked gulf which came in from the north and covered most of the central portions of Australia. On this sea floor, which was slowly sinking for a very long time, deposits were laid down which reached a thickness of 5,000 feet. The age of these beds is determined as cretaceous by the fossils which they contain being like those which lived during the chalk period of Europe. The sinking of the land at last ceased and was followed by an upward movement sufficient to drain off the sea from most of Central Australia. Then fresh water and alluvial deposits were laid down upon the elevated sea floor, giving rise to the Desert Sandstone which, through partial waste, forms the tableland country of the interior. Later movements of the earth's crust produced a sinking, or sagging of the earth's surface over the southern portion of the basin, until it became many feet below the sea level, as at present, and had the effect of directing the drainage inwards.

There is reason to believe that Lake Eyre, in its earlier history was a fresh-water lake covering a much greater area than at present, with an outlet to the sea on the southern coast. At that time the Diamantina and other large rivers had a permanent flow of fresh water and were frequented by crocodiles, turtles, and the curious mud-fish Ceratodus; large marsupials (such as the Diprotodon and others) now extinct, and giant birds of the moa and emu type lived on the plains. Central Australia had probably, at that time, a heavier rainfall and cooler climate. That a cooler climate prevailed over southern Australia at no very remote period, is further indicated by extensive glaciation, within geologically recent times, of Mount Kosciusko and parts of Tasmania, as well as a much larger icefield in New Zealand.

The surface features of the Lake Eyre basin in their larger aspects, are of three kinds. The **tablelands**—elevated flat-topped, and rocky, occurring in South Australia mostly along the southern and western sides of the basin. The **stony deserts**—forming the slopes and plains between the tablelands, strewn with hard nodules and angular fragments, called "gibbers," weathered from the Desert Sandstone of the tablelands. They are almost bare of vegetation and very trying to travel over. The **Sandhills** are produced by the waste of the Desert Sandstone and accumulate on flat country or along the lines of drainage. Wind acting on the loose sand raises it into long ridges, about 30-40 feet high, at right angles to the prevailing wind; their direction is generally north-east and south-west. The ridges are sharply defined and separated by loamy flats or clay pans, often about a quarter of a mile in breadth, which hold water for a short time after rain. They form the southern plains of Central Australia and occur largely on the eastern and northern sides of Lake Eyre. An inland basin like that of Lake Eyre, cannot get rid of its worn-down material,such as occurs when the drainage of a country flows into the sea, whilst from a deficiency of moisture, vegetation is scarce and the soil is but loosely held together. From this cause the soil and sand are constantly on the move, and with the ever accumulating products of waste, the highest hills are gradually covered by the drift, and the country is ultimately buried under its own ruins. Professor Gregory has aptly spoken of Lake Eyre as the "dead heart" of Australia. Other features of the Lake Eyre Basin are referred to under Climate, Rainfall, Artesian Basins, Vegetation, etc.

(*b.*) **The eastern group of inland basins,** including **Lakes Frome, Callabonna, Blanche,** and **Gregory,** are simply extensive flats which are sheets of water after heavy rains, and saline wastes during dry seasons. Lake Callabonna is noted for the great number of skeletons of large extinct marsupials and birds contained in its saline clays. This interesting fossiliferous area (the largest of its kind in Australia), has been reserved by the South Australian Government.

(*c*) **The south-western group of inland basins** lies between lake Torrens and the Gawler Ranges and the western plateau. It is an arid district with numerous saline flats of great extent and most tortuous outline. Of these, **Lake Gairdner** is the largest. Others have received the names of **Lake Everard, Island Lagoon, Pernatty Lagoon, Lake Windabout,** etc.

(*d.*) **The Lake Torrens Basin.**—Lake Torrens is about 130 miles in length and 30 miles in breadth, and is only second in size on the Australian Continent to Lake Eyre. It is little more than a great mud flat which holds a few inches of water after heavy rains. The floor of the lake is so level that the wind drives the shallow water before it, from one place to another, until evaporated. Lake Torrens Basin is quite distinct from the other inland basins, and forms part of the Great Valley of South Australia, which probably owes its existence to a north and south fracture in the earth's crust. The Flinders Ranges, on the eastern side of Lake Torrens, end abruptly in a bold escarpment facing the west, and continue in a great wall of rock southwards to Port Pirie and Crystal Brook. This is probably the upthrow side of the great fault which increases in importance as it passes southwards, taking in the valleys of the Gulfs. From the head of Spencer Gulf a chain of lagoons and marshy flats continue for forty miles, in a gradual rise, to 92 feet at Lake Torrens, which, as a long and narrow strip of water, occupies the north end of this central rift-valley of South Australia.

The **Murray Basin** is dealt with under River Systems.

B.—Lakes.

(*a.*) **Lakes and "Lagoons" of southern Yorke Peninsula.**—These are a remarkable group of hollows, which (as no rivers or creeks exist within the district), form receptacles for the drainage of the country.

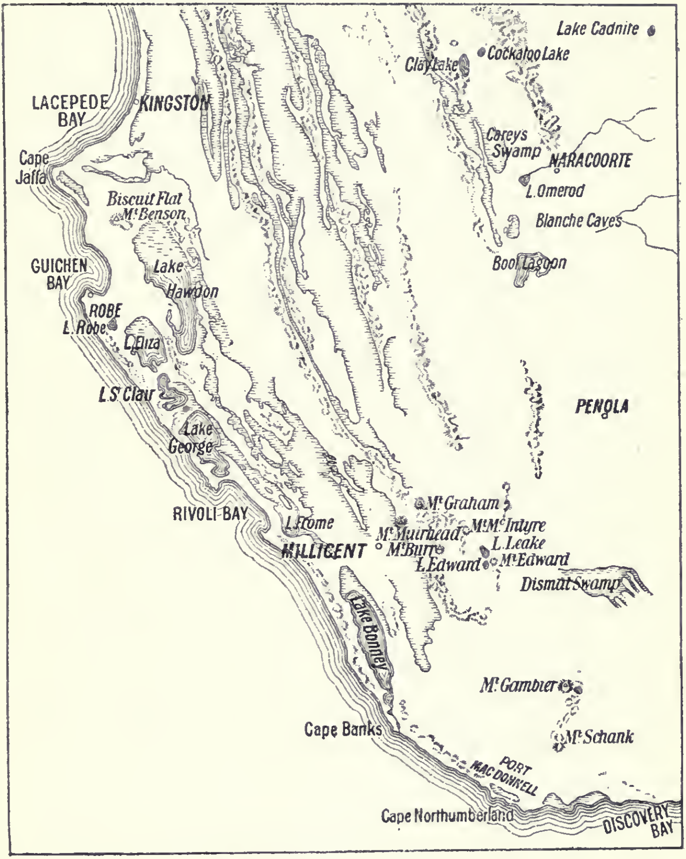

Fig. 36. Map of South-east of South Australia.

They have been formed by the partial removal of the local limestone through chemical solution, exposing a clay floor, which becomes further excavated by the wind. The drainage from the surrounding land brings with it the soluble salts, and on evaporation, a crust of gypsum and common salt covers the bottom of the lake. Both these minerals are collected for commercial purposes. Two hundred of these sunken lakes are shown on the Government map in the neighbourhood of Yorketown, the largest of which is **Lake Fowler,** ten miles in circumference. Similar depressions, yielding commercial salt, exist on Kangaroo Island.

(*b*.) **Lakes marginal to the sea.**—Lakes of this type form an extensive group in the south-east of the State, between Robe and Cape Banks. (Figs. 36 and 37.) They occupy depressions behind the coastal sandhills, and, generally, have a higher range of consolidated sandhills on their landward side, representing an older coast line. **Lake Hawdon**, the most northerly, is a great reedy morass on the eastern side of the older sandhills. **Lake Batty,** three miles south of Robe, has fresh water fourteen feet in depth. **Lake Robe** follows close behind the sandhills of the coast and in wet weather overflows into Lake Eliza. **Lake Eliza** is 12 miles long, is five feet below sea level, and salt; at its southern end it connects with **Lake St. Clair,** which is slightly smaller and also salt. Powerful freshwater springs rise at the base of the older sandhills and flow into Lake Eliza. These springs probably drain Lake Hawdon on the other side of the range. **Lake George,** near Beachport, is 108 feet above sea level, of great extent and fresh. **Lake Frome,** parallel with Rivoli Bay,

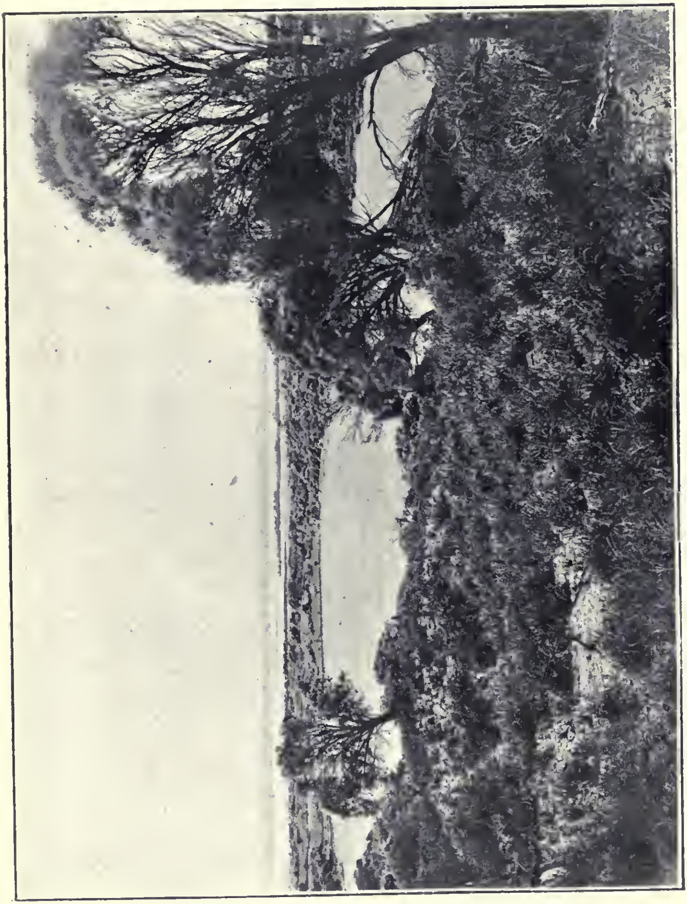

Fig. 37. Lakes marginal to the sea, south of Robe.

Photo. Com. of S.A. Rlys.

is 118 feet above sea level and communicates with Lake George. **Lake Bonney**, half-way between Rivoli Bay and Cape Northumberland, is the largest of the group, being 25 miles by 2 miles, and is fresh or brackish. All these lakes, and many others of smaller size, are fed by the local drainage and have no distinct outlets to the sea, although some have, no doubt, subterranean communications with the sea.

These coastal lakes, which form an almost continuous series, have their origin in the recent oscillations of the coast line. The sea has encroached and retreated, in turn. Great ridges of sea-borne and wind-blown sand absorb rain and obstruct drainage, impounding great bodies of water at various elevations.

A few marginal lakes, of a similar character, but on a smaller scale, occur within the limits of the Great Australian Bight, and have been referred to under the physical features of that coast.

(*c.*) **Lakes of the River Murray and the Murray Delta.**—When the Murray is in flood, its back-waters are often left in marginal depressions that form lakes or swamps, especially in the wider valley east of Overland Corner. The largest of these impounded flood waters is found in **Lake Bonney**, south-east from Overland Corner. The lake measures 4 miles by 3 miles, and is utilised as a storage basin for the irrigation of the adjacent flats.

A geologically recent elevation of the coast-line at the mouth of the River Murray has raised its old delta into dry land, through which the present river meanders and fills up its shallow basins by which the **Lakes Alexandrina** and **Albert** are formed. (Fig. 38.)

The river enters Lake Alexandrina at Wellington, over thirty miles from its mouth. The lake is a fine sheet of water, which, apart from its ramifications, measures twenty miles by fifteen miles. On its south-western side it makes the considerable inlets of Currency Creek and the Goolwa, at the same time forming numerous islands, the chief of which are Hindmarsh and Mundoo Islands. By a narrow passage, on its south-eastern side, it communicates with Lake Albert, which measures 15 miles by 10 miles. The lakes are visited by great quantities of wild fowl. This great volume of water, in common with the Coorong, finds only an

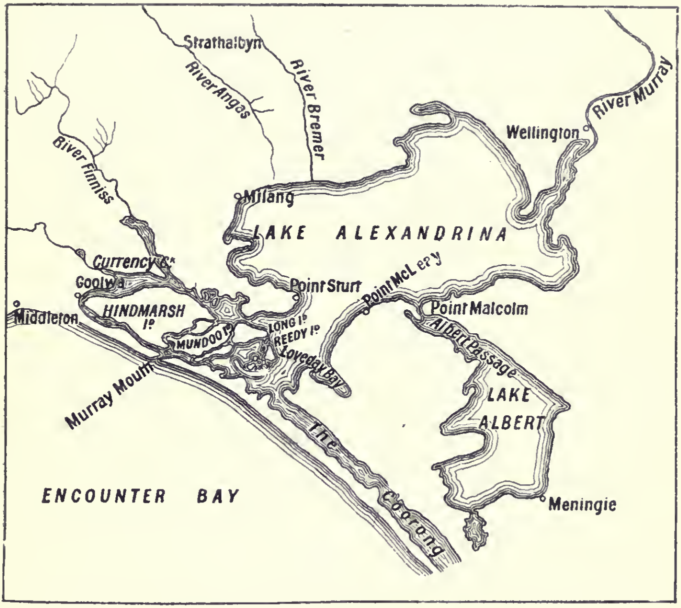

Fig. 38. Lakes at the Mouth of the River Murray.

insignificant outlet on the southern side in low sandy country. The water of the lakes is fresh, but subject to influx of salt water from the sea, which has had a tendency to increase in quantity of late years.

(*d.*) **Inland Lakes of the South-East.**—These are mostly small, round in shape, and scattered, and are produced by arrested drainage. (Fig. 36.) **Bool Lagoon,** south of Naracoorte, is the largest of this class. Other examples are **Lake Omerod,** near Naracoorte; **Clay Lake** and **Cockatoo Lake,** the two largest of a group near Keppach, to the north-west of Naracoorte; and **Lake Cadnite,** near Frances, on the railway.

(*e.*) **Lakes in Volcanic Craters.**—These are limited to the volcanic vents of the South East. The Mount Gambier group, including **Browne's Lake** (or the Crater Lake), the **Valley Lake,** and the **Leg of Mutton Lake,** which follows in a lineal direction (Figs. 39 and 40); and the **Blue Lake** (Fig. 58), separated from the former by high ground, and surrounded by vertical walls which have an average height of 250 feet. All but the first named, are not in a true sense "crater" lakes, but occupy areas of volcanic subsidences. A small lake, by subsidence, occurs at the western base of Mount Schank. **Lake Leake** and **Lake Edward** are sunken lakes on the slopes of the extinct vent of Mount Burr. Lake Leake has an elevation of 326 feet above sea level, and is fed by local drainage. (See also under Volcanoes of South Australia.)

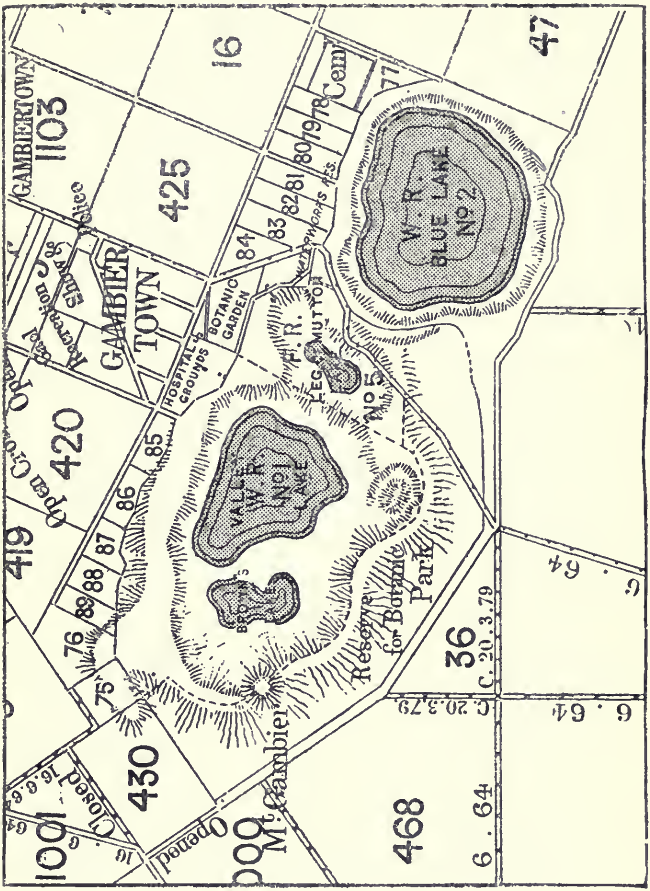

Fig. 39. Plan of Volcanic Lakes of Mt. Gambier.

CHAPTER V.—RIVER SYSTEMS AND ARTESIAN WATER.

When the vast extent of central and southern Australia is considered, it is remarkable how few rivers of importance occur within the area. To the west of Eyre Peninsula there is practically no running water until we get as far inland as the Everard and Musgrave Ranges, on the northern boundaries of South Australia, and within the great inland drainage area. The agricultural uplands of Wirrabarra, Belalie, and Petersburg, and a continuation of the same broad ridge to the New South Wales borders, form the main water-parting in South Australia between north and south. All drainage north of this ridge, with the exception of a narrow belt near the head of Spencer Gulf is inward; and all drainage south of that line is directed towards the southern sea. A few insignificant streams drain into the two Gulfs and Encounter Bay from the adjacent highlands, and with the exception of the Murray, there is no drainage to the sea worth mentioning between the Gulfs and the Victorian border.

There are evidences, however, that in past ages, Central Australia had a much better supply of running water than it has to-day. The primitive (Pre-Cambrian) mountain ranges, which still remain (though greatly reduced in size), are the MacDonnell, Musgrave, Gawler and other ranges; and the still more important ranges that once occupied the site of the Murray Flats and the Continental Shelf of the south coast, were, in remote times, the great watersheds of

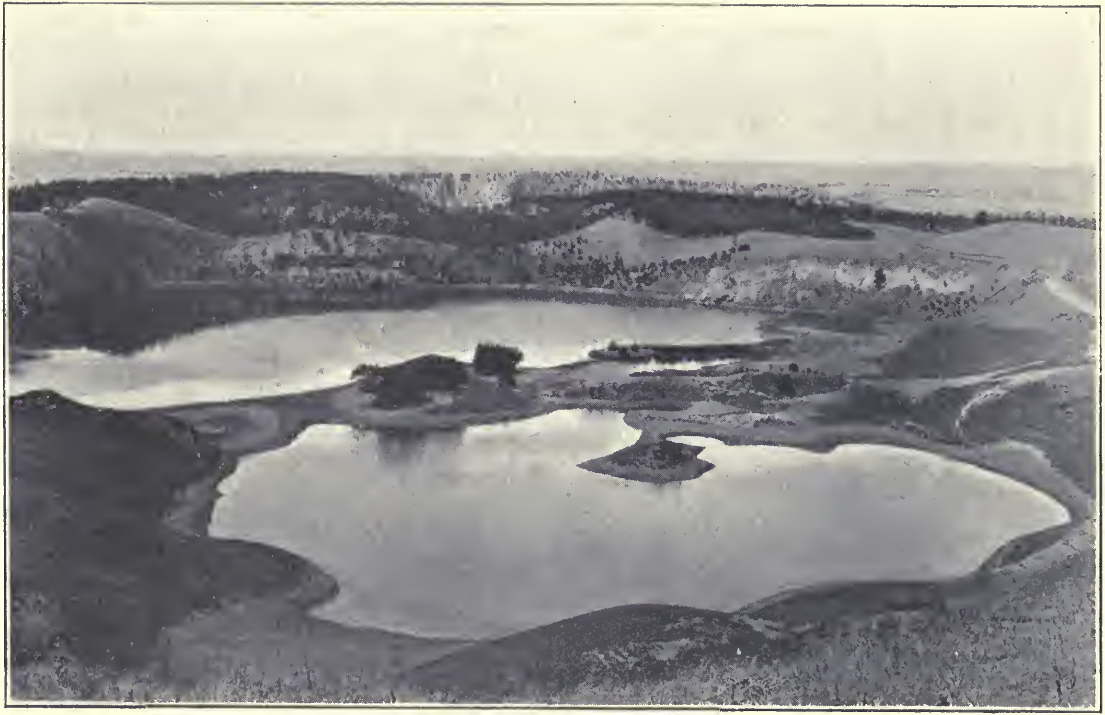

Fig. 40. Bird's-eye View of the Mt. Gambier Lakes. Browne's Lake (or the Crater Lake) is in the foreground, with the Valley Lake next. The Leg of Mutton Lake and the Blue Lake lie in the depressions which are seen in the same line of perspective in the distance.

the country. Even as late as the mid-glacial period of Australia, that occurred at nearly the same time as the formation of the coal deposits of New South Wales, the southern coast ranges discharged their glaciers (when the two Gulfs were upland valleys) towards the north. The floor over which the ice moved along the Inman and Hindmarsh Valleys is, in its deeper portions, now 800 feet below sea level.

The comparative absence of rivers in South Australia, at the present time, arises from several causes. The removal of the highlands by denudation, a scanty rainfall, earth movements which have completely altered the physical conditions of the interior, and the fragmentary character of the drainage system, are amongst the chief causes known to us. (See pp. 123-125.) There may be other causes of a cosmical character which at times influence the climates of the earth, on a larger scale, but of these we have an imperfect knowledge.

The hydrographic features of South Australia belong to three very distinct types. (*a*) Inland drainage. (*b*) Drainage to the sea. (*c*) Subterranean, or Artesian Waters.

A.—Rivers of Inland Drainage.

The inland drainage system has its chief centre in Lake Eyre Basin, with numerous subordinate basins around the margin of the latter. The **Finke, Hugh, Todd, Hale,** and other streams, take their rise in the MacDonnell Ranges, but their waters are lost in the sands before reaching Lake Eyre. The **Plenty, Marshall,** and **Arthur** Rivers, take their rise to the north of the MacDonnell Ranges, and after flowing eastward, unite to form the **Hay River**, which is lost in the sandy flats on the Queensland borders.

The Musgrave Ranges give rise to the **Agnes** and the **Marryat**, which unite to form the **Alberga**, and then, with the **Hamilton** and **Stevenson**, unite to form the **Treuer** or **Macumba** which flows into the northern end of Lake Eyre.

The **Neales**, fed by the **Henrietta** (or Arckaringa) and many tributaries from the Peake and Denison Ranges, flows into the north-western portion of Lake Eyre.

Warriner Creek and **Stuart** (or Chambers) **Creek** enter Lake Eyre South on the west, which also receives numerous short rivers that drain the Hermit and Willouran Ranges on the south ; whilst the **Frome** drains the northern Flinders, and after a course of 140 miles, enters Lake Eyre at its south-eastern extremity.

The greatest influx of water into Lake Eyre is supplied by the **Diamantina** or **Warburton** and the **Barcoo** (or **Cooper Creek**), which enter the Lake on its eastern side and form a sandy delta which gives a special feature to the district. These rivers receive the tropical rains which fall upon the Dividing Range of Queensland and drain the great western plains of that country. They flow for months after heavy rains, and in the case of the Cooper, may be twelve miles wide. The enormous quantity of fresh water conveyed to Lake Eyre, without filling its basin has led some to think that the water finds an underground passage. But the intermittent manner in which the rivers run, the vast area over which they are spread, and the very rapid evaporation (which in

Government tanks, near Lake Eyre, amounts to 100 inches in the year), are probably sufficient reasons for this failure.

Strzelecki Creek is an overflow of the Cooper, near Innamincka, and feeds Lakes Blanche and Callabonna.

The north-eastern Flinders gives rise to numerous creeks which flow in rocky gorges and find their way to Lake Frome, amongst which are the **Paralana, Balcanoona,** and **Mount Chambers Creeks.** The **Siccus River** unites with the **Pasmore River** (or Wilpena Creek), flows north, drains the low country lying to the east of the Flinders Ranges and enters the southern end of Lake Frome.

The rivers, of which there are countless numbers in this great inland system of drainage, have much in common. None of them are permanent (only running when in flood from torrential rains), they are quickly reduced to waterholes, or are completely dry through long periods of time. The beds of the rivers are usually shallow and broad, covering great stretches of country subject to inundation. Rivers that take their rise in rocky uplands, as the Musgrave and other ranges, have a rapid descent over rocky ledges until they reach the sand slope, which has been driven by the wind up the sides of the ranges. Here Eucalyptus trees occupy the beds and sides of the streams forming the common feature of "gum creeks." As the water reaches lower ground, and deeper sands, it becomes entirely absorbed and lost.

These peculiar hydrographic conditions present, however, some compensating features. The rivers which disappear below the surface in sandy creeks are placed beyond the limits of surface evaporation, and are often made available, either by rock barriers crossing the stream, which bring the water to the surface, forming a water-hole; or produce soakages by which the traveller can get supplies in the desert on sinking a few feet in the bed of the stream. In a similar way, the sandhills-country holds much of the rainfall by absorption. This finds its way down to the clay floor on which the sand ridges rest, and then slowly gives out at the base, forming a marsh or shallow lake of fresh water on the clay flats which lie between the sand ridges. These are known as clay-pans and may contain water after rains for weeks, or even months. The "native wells," at the base of sandhills have a similar origin. Were it not for these natural conditions of water conservation, Central Australia would be impassable to the traveller and useless to the pastoralist.

The Rivers of Lake Torrens Basin are, for the most part, short and unimportant. The north-western Flinders Ranges are drained by numerous creeks to the westward, but their waters are mostly lost in sandy flats before reaching the lake. The most important water-course of the basin is the **Willochra Creek**, which takes its rise on the east and west watershed, and with its tributaries, **Wild Dog**, **Booleroo**, and **Spring Creeks**, drains Mount Remarkable and the Booleroo and Willochra Plains, and after a course of 100 miles, enters Lake Torrens near its southern end.

B.—Drainage to the Sea.

The country from the head of Eyre Peninsula to the Western Australian borders has no drainage to the sea in the form of running water.

The **River Broughton**, with its tributaries, the **Hut** and **Hill Rivers, Freshwater, Yackamoorundie.** and **Bundaleer Creeks, Rocky River** and **Crystal Brook**, drains the elevated peneplain of the northern agricultural areas, and is lost in the mangrove swamps, on the coast, between Port Pirie and Port Broughton.

The Rivers of Gulf St. Vincent all take their rise on the eastern side of the Mount Lofty Ranges, and penetrate these ranges in their passage to the sea. The principal are the **Wakefield**, which finds an outlet at Port Wakefield. The **Gilbert** flows through Riverton, and unites with the **River Light**, near Hamley Bridge. but the combined streams fail to reach the sea. The **North** and **South Para Rivers** unite at Gawler to form the **River Gawler.** The **Torrens**, which rises near Mount Pleasant, flows through the city of Adelaide and is absorbed in the sands and "reed-beds" before reaching the sea. The **Onkaparinga** finds an outlet to the sea at Port Noarlunga. The rivers Torrens and Onkaparinga are, in their upper reaches, mature rivers, and have reduced their beds to a uniform grade or level, while many of their tributaries, such as the **First Creek** (Waterfall Gully) and the **Fourth Creek** (Morialta), confluents of the River Torrens, show their relative youthfulness by possessing a succession of waterfalls in their courses.

The **Inman** and **Hindmarsh Rivers** flow into Encounter Bay. These rivers are re-excavating an old glacial valley which is choked with morainic material. The **Finniss** flows into the Goolwa; and the **Angas, Bremer,** and **Murray** into Lake Alexandrina.

Apart from Spencer and St. Vincent Gulfs, which may be regarded as drowned valleys, the **Lower Murray** presents the only important basin of South Australia that is open to the sea. The great basin of the Murray River drains the western flanks of the coastal ranges from Central Queensland, through New South Wales and Victoria to the Great Dividing Range and Grampians of the last named State.

The **River Murray** enters South Australian territory near the 34th parallel of south latitude, and flows south-west to the Great Pyap (or South) Bend. Then taking a north-westerly course, it once more, at the North-West Bend, nearly reaches the same parallel of latitude. From this point it takes a course almost due south to the sea. Its low gradient, over so great a distance, is extraordinary. At the point of entrance to South Australia, its summer level is only 57 feet above sea (low water) level. At Morgan (North-West Bend), it is only 5 feet 4 inches, and this at a distance, in a straight line, of 120 miles from the sea, amounting to a gradient of only a half-inch to the mile in direct measurement. The river has long since reached its base level and ceased to deepen its bed; its work of erosion being limited to wearing away its banks. Its course is consequently extremely tortuous. From the New South Wales boundary to Overland Corner, in a direct line, is 40 miles; by river it is 143 miles.

The river-course within the limits of South Australia is divisible into four sections:—

1. **From the New South Wales boundary to Overland Corner.**—Here the course of the river is through an open valley, 2½ miles to six miles wide,

bounded by sandstone cliffs of a newer age than the limestones and sandstones which form the boundaries of the river lower down. The late Professor Tate regarded this section of the Murray as an old lacustrine area which has been drained by cutting down the lip at the overflow point at Overland Corner. In this section the river winds through extensive flats that in flood times become a complex reticulation of creeks and billabongs. These store the backwaters of the river and slowly give them out again as the river falls.

2. **The upper gorge from Overland Corner to North-West Bend.**—At Overland Corner the gorge is contracted to a mile (with cliffs 200 feet high) and averages 1¼ miles wide to North-West Bend, with Kainozoic sandstones and limestones forming the cliffs.

3. **From North-West Bend to Wellington** the gorge still further contracts to three-quarters of a mile, with steep and high limestone cliffs (Fig. 41) often rich in Kainozoic fossils.

4. **The Lacustrine, or raised Delta**, extends from Wellington to the Mouth of the Murray, and embraces the Lakes and numerous channels and islands of the coastal section. These have already been considered under Lakes. (Fig. 38.)

The drainage which the Murray receives within the limits of South Australia is very slight; the **Burra Creek**, which enters the river at North-West Bend, and the **South Rhine**, are the principal streams. The summer level of the river from February to May is reckoned as the zero of its volume. An improvement generally begins in June when the effects of the winter

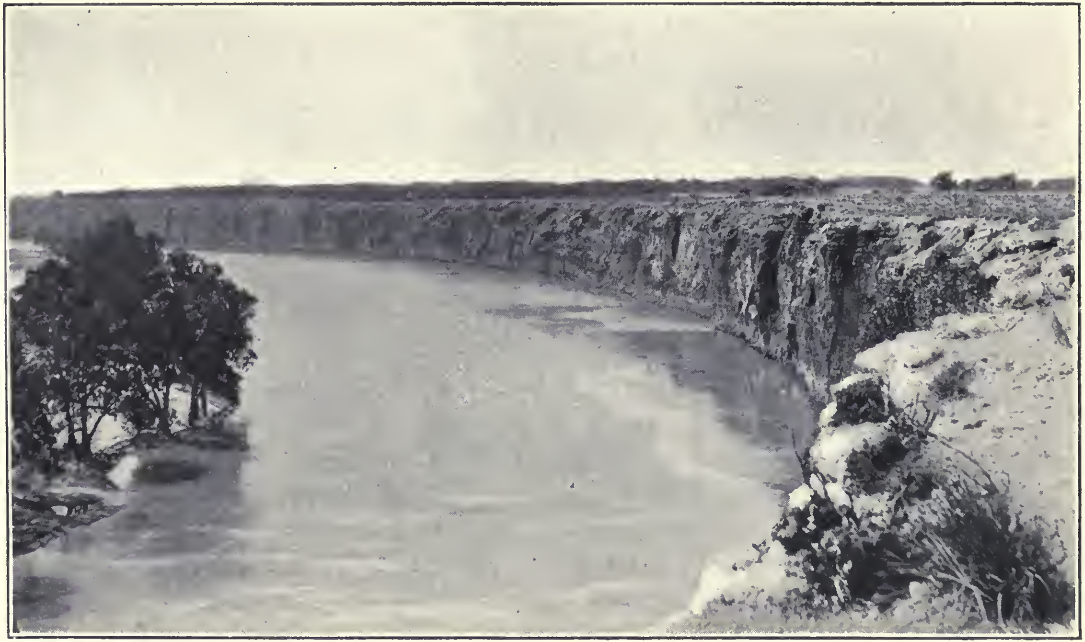

Fig. 41. The Gorge of the River Murray, between Blanchtown and Mannum, shewing vertical cliffs of Kainozoic Limestone.

rains are first seen. The melting of snows on the eastern highlands, yields the greatest volume of water which reaches a maximum between October and December. The **Darling** conveys the flood waters of tropical Queensland, which are uncertain in their occurrence, but at times, they coincide with the early summer rains from the eastern snow fields, when there is an exceptionally high river. By the courtesy of Mr. J. W. Jones (Secretary to the Commissioner of Public Works), I am able to quote the following figures as to the volume of the Murray waters: the zero gauge at Morgan, summer level, gives 100,000 cubic feet per minute; when the water rises on that gauge about 5½ feet, the volume discharged is 450,000 cubic feet per minute; in a fairly high flood it reaches 800,000 cubic feet.

The Murray is fed principally by flood-waters, and therefore contains a very low proportion of mineral substances in solution. This proportion is of course least in flood times, and greatest at summer low water. The following is an official analysis, made by the Engineer-in-Chief's Department, from water taken at Renmark on January 8, 1903, when the river was low but still falling, and shows a higher proportion of mineral contents than the normal, viz.:

	Grains per gallon.
Sodium and Potassium Chloride	13.89
Magnesium Chloride	1.95
Magnesium Sulphate	2.06
Magnesium Carbonate	0.35
Calcium Carbonate	2.58
Silica, &c.	0.86
Total	21.69

The late Professor Tate gave results of an analysis, also made in January, which yielded only 7 grains per gallon, of which 3.9 grains were calcium carbonate. The soluble salts are chiefly derived from the back waters, which are impounded by floods, and later find their way into the main stream, giving greater salinity to the river when low.

The River Murray, after flowing through Lake Alexandrina and between the islands of the delta, finds an outlet to the sea through the coastal sandhills. (Fig. 38.) The depth of water on the bar is about twelve feet, but from the nature of its banks, and the set of currents from various channels, its outlet is apt to change its position. Vessels of light draught can utilise the entrance, but at present the river is mainly used for purposes of inland navigation.

C.—RECENT CHANGES IN THE RIVER SYSTEMS.

South Australia has undergone oscillations of level which have greatly affected the lines of drainage. Within comparatively recent times the lesser heights of the Mount Lofty and the Barossa ranges were at a lower altitude in relation to the sea than they are at present, and the river valleys were worn down to base level. Remains of these old river deposits occur along the tops of the foot-hills. An elevation of some hundreds of feet slowly took place. The rivers, which through long ages had worn down their beds and widened their valleys, began to act on steeper grades. By their increased power of erosion they cut through their own deposits deep into the underlying rock, forming deep and narrow gorges, and were thus "renewed" or "rejuvenated."

The River Torrens, as well as the Onkaparinga, formed part of the older systems of drainage, but on the elevation of the country they kept pace with the movement of elevation and, by cutting deeply into the rising barriers, maintained their outlet to the sea. To do this, however, some rivers became diverted into new channels. The Onkaparinga, for example, formerly occupied the wide valley of the Kangarilla flats and McLaren Vale, and entered the sea by an estuary, bounded on the south by Sellick's Hill. Later, the river, (choked back by its own sediments), deserted its old bed at a point near Mount Bold, and making a sharp return curve to the north, after cutting out for itself a new channel in the hard rocks, found an outlet to the sea twelve miles north of its former mouth. The two rivers, just referred to, possess the unusual features of having their watersheds more matured, in their stages of erosion, than the lower portions of the water-courses—a direct effect of the elevation of the country.

Many of the longitudinal ("subsequent") rivers, belonging to the older systems of drainage, have been drained by the newer transverse ("consequent")* streams which were called into existence, or revived, by the latest elevation of the ranges, coupled with the sinking of the rift-valley on the west. The western escarpments of the Mount Lofty Ranges supply illustrations of these younger lines of drainage in every stage of development.

A similar movement of elevation led to the establishment of the water-parting in the neighbourhood of Jamestown and Petersburg, referred to above.

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*When a flat country is slowly raised from its base level, the drainage runs down the slopes of the ridge as a "consequent" of such elevation giving rise to young rivers which cut their channels transversely to the ridge. In a later stage of river development the main stream receives the waters of lateral tributaries, which drain the valleys between the ridges and these latter are called "subsequent" streams, because they are of later origin than those caused, in a direct way, by the elevation of the land.

Before this bulging of the earth's surface took place the drainage of the Lake Torrens district found its way to the head of Spencer Gulf; whilst the Willochra Creek, the Rocky River, the Broughton, and other streams flowed south into the head of St. Vincent Gulf. The elevation of the east and west ridge intercepted the older lines of drainage and diverted most of the streams towards the north or west. This reversal of the drainage was probably gradual, and at one stage of the earth-movement led to the formation of fresh-water lakes, some of which have been subsequently drained and others have become salt.

D.—ARTESIAN WATER SUPPLIES.

(*a.*) The great **Artesian Basin of Central Australia,** in a general sense, is co-extensive with the Lake Eyre Basin. It includes Central and Western Queensland (380,000 square miles); North-western New South Wales (60,000 square miles); the north-eastern portions of South Australia (120,000 square miles); and the south-eastern portions of the Northern Territory (30,000 square miles). The intake is chiefly by porous sandstones, probably of different geological ages, which outcrop on the western flanks of the Queensland and New South Wales Ranges, and underlie the western plains of these States. These intake beds are covered by great thicknesses of dark blue shale, sandstones, and impure limestones of Cretaceous age. It is often called the Cretaceous Artesian Basin. The southern and western limits of this basin are determined by the outcrops of the older rocks, which act as an impervious barrier to the subterranean water and in many places force it to the surface. From Hergott, northwards, the western boundary of the artesian basin is approximately indicated by a long chain of springs, many hundreds in number, which follow along its margin. By the precipitation of the minerals in solution, many of these outlets are marked by calcareous mounds, 10 to 60 feet in height, the water flowing over from a basin formed on the summit. Blanche Cup, five miles south-east of Coward Railway Station, is one of the most symmetrical of these "Mound Springs." It is a calcareous-sinter mound, 30 feet high, with a basin of water 75 yards in circumference, almost clear of reeds on the summit. The water is shallow around the rim, but very deep in the centre. Mounds of extinct springs occur along this line, and are of much greater magnitude than those that are now flowing. Springs marginal to the artesian basin also occur in great numbers at the base of the Flinders Ranges, along their north and north-eastern escarpments. Some of these are mud springs, and the Paralana Spring has a temperature, at the surface, of 130° F.

The artesian basin deepens north-easterly from Lake Eyre South, reaching a maximum of 5,000 feet near the Queensland border; while the height to which the artesian water will rise above sea level, increases in the same direction, from 200 feet at the south end of Lake Eyre South, to 550 feet near the boundaries of South Australia and Queensland, and 1,200 feet at Charleville, in Queensland. The South Australian Government, in addition to scattered bores in many parts of the area, has established a series of bores and wells along the Birdsville (Queensland) track, making it possible to pass over this dry country in safety at any season. (Fig. 42.)

The temperature of the artesian water is largely regulated by depth, and is relatively high. The following instances are given, in illustration, from information kindly furnished by Mr. J. W. Jones, Secretary to the Commissioner of Public Works:—

NAME OF BORE.	Depth in Feet.	Gals. per day.	Temp. at Overflow.
Coward: Near S.W. margin of basin	308	1,000,000	95° F.
Oodnadatta	1571	270,000	113° F.
Anacoora: East of Charlotte Waters, near N.T. boundary	1250	700,000	135° F.
Kopperamanna: On Birdsville track	3000	800,000	176° F.
Mount Gason; ,, ,,	4430	480,000	204° F.
Goyder's Lagoon; ,, ,,	4850	600,000	208° F.

The marked increase of temperature with depth, shown in the above Table, is not referable to a volcanic origin, but to a law of increase of heat, from the surface downwards, which exists in every part of the world. After the superficial zone of seasonal temperature is passed through (which amounts to about 50 feet), the temperature rises at an average ratio of 1° F. for each 50 or 60 feet, although many localities show a considerable range of variation in this respect. Thus the Australian artesian system gives a high rate of increase of heat in relation to depth. The deepest bore, Goyder Lagoon, shows 1° F. for each 36 feet; and the general average of the six instances given above is about 1° F. in 27 feet. The shallower bores may be fed from waters on a rising gradient, and thereby give a temperature above the normal of the stratum in which they are tapped.

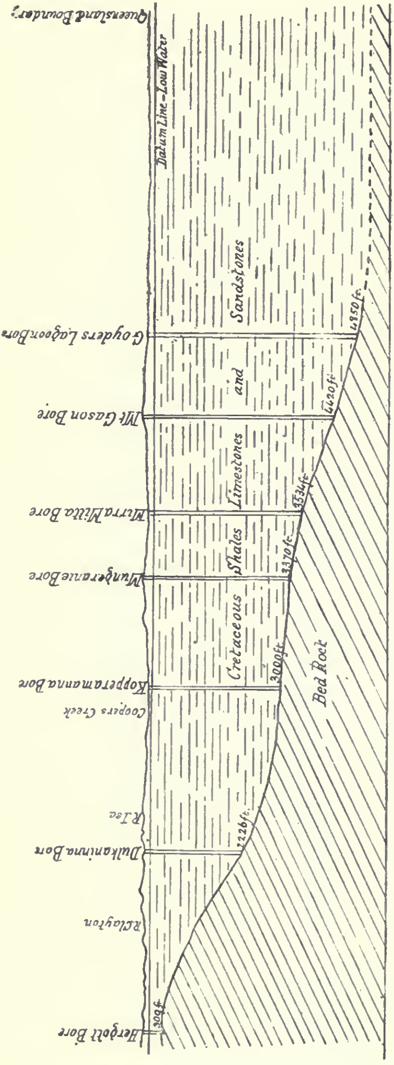

Fig. 42. Section (300 miles) across the Artesian Basin, on the Birdsville Track from Hergott to the Queensland Border. (From data kindly supplied by Mr. J. W. Jones, Sec. to Com. of Public Works.)

The water though more or less brackish is suitable for cattle and other purposes and is a great boon to pastoralists and travellers. That the subterranean water has a common source throughout the great extent of the basin is doubtful. There are probably sub-basins within the limits of the larger one. It is believed that the artesian water in New South Wales is drawn from Triassic sandstones, which are much older than the Cretaceous; and Tate and Watt believed that much artesian water in the neighbourhood of Lake Eyre has its origin in the Finke River basin. The approximate freshness of the artesian water is probably secured in part by the overflow at the lip, on its southern and western sides, and it is not unlikely that in some parts of the basin it has an outlet by subterranean channels to the sea; or the supply may be, in some cases, local, as suggested by Tate and Watt, and therefore has not been subjected to much mineral contamination.

(*b.*) An **artesian to sub-artesian basin,** has been proved by several bores to exist in the **Adelaide plains.** The source of the water is from the western slopes of the Mount Lofty Ranges by means of the buried alluvial fans and sand beds which slope from the hills. The water-carrying beds are at various depths, lenticular in their occurrence, and somewhat uncertain. The area is circumscribed by a curve which, beginning near Brighton, in the south, passes through Adelaide, skirting the ridge of old rocks near Dry Creek, goes between Smithfield and Penfield, and again curves to the coast near Dublin. Shallow bores, to 100 feet or 150 feet, give fresh water, but as the depth is increased the water becomes tainted from the decomposition of the old slate rocks and is too saline for irrigation purposes. The first of the trial bores was made at Dry Creek Smelting Works, and tapped artesian water of inferior quality, at 410 feet, with a yield of 100,000 gallons per day. Very good water has been obtained near Virginia and other places towards the sea board, where the flow is either artesian or rises to within a few feet of the surface. Nearer the hills the water rises to a less height in the bores. The water is being extensively used for cultivation but in all cases the supplies must be obtained from the shallower depths.

CHAPTER VI.—EXTINCT VOLCANOES OF SOUTH AUSTRALIA.

There is no active volcano in Australia. Yet within times, not far distant geologically, the eastern and south-eastern parts of Australia formed a ring of volcanic fires. The subterranean fires have become extinct in Australia, whilst the foci of volcanic activity have been developed in a curve, further to the east, in which New Zealand participates. The south-eastern part of South Australia, as well as Kangaroo Island, appears to have been at the western extremity of this igneous activity of southern Australia, but the subterranean forces were relatively weak and possessed little power of eruption.

The most important volcanic centre was at **Mount Gambier.** The highest peak of the Mount forms the southern segment of the original crater cone, with the Crater Lake (Browne Lake), at its inner base. (Figs. 40 and 43). The northern and eastern parts of the cone have been largely denuded, or perhaps swallowed up, in the collapse of that side of the Mount. The igneous foci operated apparently at shallow depths, as the ejected rock fragments consist almost exclusively of the local Kainozoic limestone, which is a horizontal surface layer. A slight flow of lava occurred at the early stages of the outbreak, and is seen in section in the walls of the Valley and Blue Lakes, but it was, in the main, a cinder and mud volcano. The ash and scoriae not only accumulated around the vent, but were carried by the winds over an area extending to seven miles in a north-easterly direction—the direction of prevailing

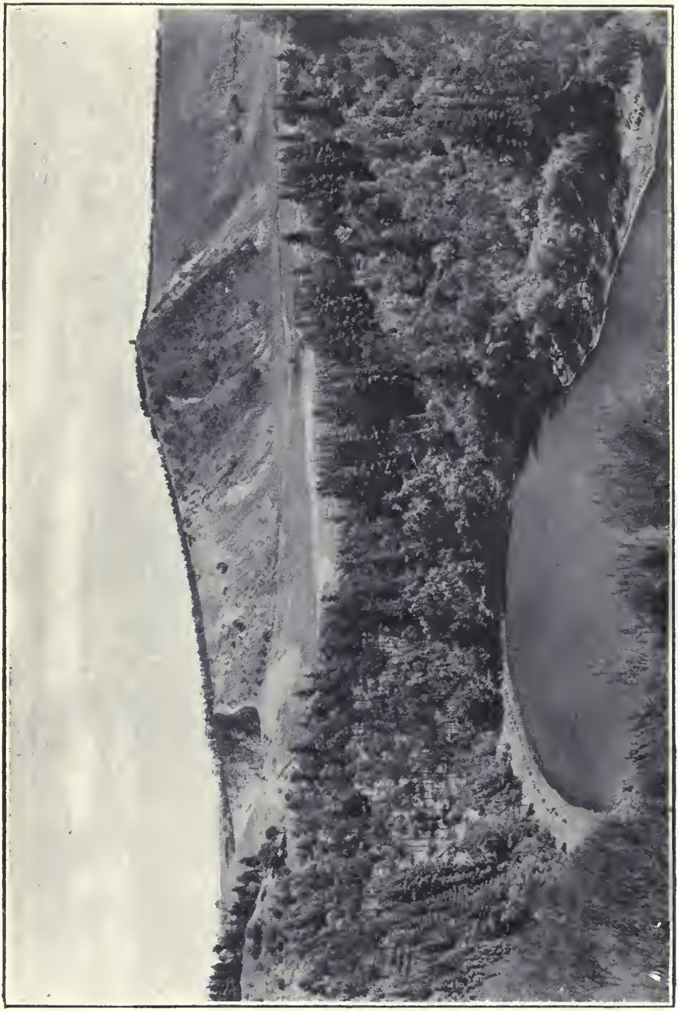

Photo Com. of S. A. Rhys.

Fig. 43. Mt. Gambier with segment of Crater, seen on the right hand, and area of subsidence on the left. The Leg of Mutton Lake is seen in the foreground.

winds. Towards the close, or perhaps after the eruption had ceased, the sides of the Mount caved in in two directions; in one case leading to the formation of the **Crater**, the **Valley**, and the **Leg of Mutton Lakes**; and in the other, a little further to the south, the **Blue Lake.** (Fig. 39 and 40.) The latter forms a striking feature—a deep pit on the slopes of the Mount, half-a-mile across, with vertical cliffs 250 feet in height, banded by coralline limestone near the water, black basalt (50 feet) in the middle, and ash beds to the surface; and, at the bottom lies the placid water of the lake, which may appear in varying shades from a light to dark blue. The water has a depth of about 250 ft., giving a 500 ft. fracture of the crust, in addition to a cavity below, equal to the swallowing up of the 500 feet of roof that went down with the subsidence. That these sunken pits, containing the four Mount Gambier lakes, are subsidences rather than extinct craters, is evident from the fact that the quaquaversal* dip of the ash beds shows a uniform slope from the highest part of the hill, thereby indicating the position and singleness of the volcanic vent. That so much of the surface caved in around the crater is a further evidence of the shallowness of the volcanic forces.

Mount Schank is an isolated cone 320 feet in height, rising from the plain eight miles south of Mount Gambier. (Fig. 44.) It is almost perfect in outline, but has a fracture and partial subsidence on the south side. The crater, which is 200 feet deep, contains no water, but there is a small lake at the foot of the Mount on its western side. The cone is entirely composed of volcanic tuffs and ejected stones. One limestone fragment thrown out by the volcano, is twenty feet in diameter. As compared with Mount Gambier, this volcano produced lava at the later stages of its activity, from rents external to the crater, in the side and base of the Mount. These outflows were on its western side and have produced a lava field, one and a quarter miles long and three quarters of a mile wide around the western side of the Mount.

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*Dipping from a centre towards every side.

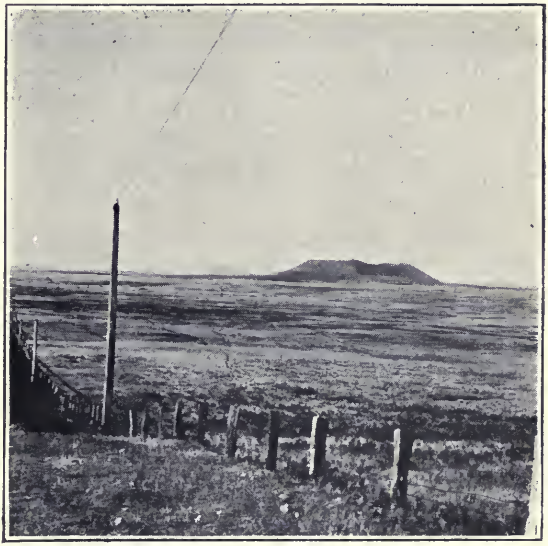


Photo. J. Greenlees.

Fig. 44. Mt. Schank seen from a distance. Mt. Gambier can be discerned on the horizon.

Another volcanic area is situated about eighteen miles north-west of Mount Gambier. **Mount Burr**, 750 feet above sea level, appears to have been the principal vent. Lava streams occur on the slopes of **Mount Graham** (426 feet), six miles north of Mount

Burr; and also on **Mount Muirhead** and **Mount McIntyre**. **Mount Leake** (326 feet), and **Mount Edward,** are situated five miles to the east of Mount Burr, with which they are connected by a slope of volcanic ash. Each of the two latter has a lake in a depression at its summit, but whether they represent craters or subsidences is uncertain. The lakes are formed by local drainage from rain.

The period at which the volcanic activity occurred in the South East is indicated by the geological deposits and organic remains found beneath and enclosed within the ejected ashes. Post-pliocene clays and soils underlie the ash beds. The latter enclose impressions of trees and plants of species still growing in the neighbourhood, such as *Eucalyptus, Casuarina, Banksia,* etc., and extinct marsupials of late Pliocene or Post-pliocene age, proving the comparatively recent times when these vents were active.

A third volcanic area occurs in the north-eastern parts of Kangaroo Island. A fissure-vent can be seen on the coast near to the entrance of the Bay of Shoals, and a large sheet of basalt, representing an old lava flow, fills up old river valleys near Kingscote and extends in a broken tableland from Kingscote to Smiths Bay, a distance of twelve miles. It is probably of the same age as the volcanic areas of the South-East.

REFERENCES.

See Tenison Woods, Geological Observations in South Australia, 1862; Ralph Tate, Anniversary Address Philosophical Society of Adelaide, 1879; H. T. L. Brown, Parliamentary Paper, No. 256, of 1884; W. Howchin, Extinct Volcanoes of South Australia, Transactions Royal Society South Australia, 1901.

CHAPTER VII.—EARTHQUAKES IN SOUTH AUSTRALIA.

Earthquakes are usually either connected with volcanic phenomena, or the result of fracture and displacement of parts of the earth's crust. These movements give rise to "faults" in the strata. Earthquakes may follow from the initiation of a new fracture, or occur in a series of movements either up or down along an old-established fracture. The earthquakes of South Australia probably belong to the last named class.

A seismograph was installed at the Adelaide Observatory in 1908. It is designed to record distant earthquakes, and, in conjunction with other instruments of a like kind, can locate centres of earthquake disturbance thousands of miles distant from the recording instruments. It has already done useful work in this direction. The following list of South Australian earthquakes has been taken from Sir Charles Todd's reports to the Seismological Research Committee of the Australasian Association for the Advancement of Science. We give the number of shocks observed for each year quoted; the dates of shocks, and the localities, when felt in more than one place; and the number of isolated shocks, or those which had a single place of observation.

1893.—Eight shocks: Aug. 13, Freeling, Kapunda, Eudunda, Angaston, Friedrichswalde, and Riverton. Isolated occurrences, seven.

1894.—Six shocks: Aug. 7, Kapunda and Eudunda; Dec. 9, Beltana and Blinman. Isolated occurrences, four.

1897.—Fourteen shocks: Jan. 29, Beltana and Blinman; April 27, Wirrabara, Georgetown, and Gladstone;

May 10, all parts of the Colony south of Port Augusta; Sept. 11, Hawker, Beltana, and Blinman; Nov. 8, Kapunda and Eudunda; Nov. 2, Nairne and Woodside. Isolated occurrences, eight.

1900.—Eleven shocks, all isolated. Four shocks occurred at Beltana between January 15th and March 6th, with numerous slight tremors in the interval.

1901.—Two shocks, both isolated.

1902.—Twenty shocks: Feb. 14, Caltowie and Georgetown; May 7, Laura, Hammond, Bruce, Carrietown, Black Rock, Eurelia, Wirrabara, Appila Yarrowie, Adelaide, Yongala, Bendleby, Georgetown, Hallett, Mitcham, Orroroo, Port Germein, Port Pirie, Quorn, Wilson, Wilmington, Whyte Yarcowie, Willowie, East. May 14, Marrabel and Eudunda; June 4, Barossa and Williamstown; June 6, Caltowie, Gladstone, Wirrabara, Laura, Appila Yarrowie; Sept. 19 and 20, felt over all settled parts of the State. Tremors were also experienced in some places on Sept. 21; and on the 24th a sharp shock was felt at Port Wakefield, at which place about thirty shocks were recorded between Sept. 19 and Oct. 7, mostly slight. Isolated occurrences, eleven.

1903.—Nine shocks: Feb. 6, Hammond and Bruce; April 7, Appila Yarrowie and Gladstone; Aug. 14, Port Wakefield, Blyth, Brinkworth, Balaklava, and Hoyleton; Nov. 16, Hamley Bridge, Freeling, and Eudunda. Isolated occurrences, five.

Omitting from consideration the two great earthquakes of May 10, 1897, and September 19-20, 1902; and not counting isolated occurrences, the following are the numbers of shocks felt in each locality as reported to the Seismological Research Committee, for the years noted as above.

One shock.—Adelaide, Angaston, Balaklava, Barossa, Bendleby, Black Rock, Cape Borda, Cape Northumberland, Eucla, Echunga, Friedrichswalde, Hammond, Marrabell, Murray Bridge, Nairne, Penola, Petherton, Port Augusta, Port Pirie, Quorn, Riverton, Tanunda, Whyte Yarcowie, Williamstown, Willowie E., Wilmington, Wilson, Woodside, and Yongala.

Two shocks.—Bruce, Caltowie, Carrieton, Eurelia, Freeling, Gladstone, Orroroo, Port Germein, Redruth and Warrina. *Three shocks.*—Georgetown, Hallett, and Laura. *Four shocks*—Appila Yarrowie, Eudunda, Hawker, Kapunda, and Wirrabara. *Eight shocks.*—Blinman. *Ten shocks.*—Beltana. *Thirty shocks* in 19 days at Port Wakefield during the great seismic disturbances in September and October of 1902.

Mr. G. F. Dodwell, Government Astronomer for South Australia, has supplemented Todd's list, bringing the records down to the end of 1908. (See "South Australian Earthquakes," Aus. Asso. Ad. Science, Brisbane, 1910.)

The two general earthquakes of South Australia that occurred, one in 1897 and the other in 1902, are probably the most severe that have been felt in Australia since its settlement by the white races. These may be briefly described.

The Kingston Earthquake, May 10, 1897.—This earthquake affected an area including all the south-eastern portions of South Australia, as far north as Port Augusta; it extended to Menindie, on the Darling in New South Wales; and through western Victoria as far as Melbourne, including a part of Tasmania. The maximum of intensity was felt along the south-east coast line, at Kingston, Robe, and Beachport, which were severely shaken and had many buildings cracked and partially demolished. The jetty at Robe was twisted and the iron rails for trucks on the jetty were bent. The zone in which injury was done to buildings extended from Adelaide to Mount Gambier. In the Kingston and Robe districts, rents were produced in the ground eight and nine feet deep which, at the moment of the shock "spouted sand and water," in great quantities. The shock was felt at sea, off Kingston, and the master of the steamer Waroonga, who was in the neighbourhood of MacDonnell Bay, thought he had struck a reef and manned the pumps. The lighthouses off the coast suffered more or less, and the head keeper of Penguin Island Lighthouse, near Beachport, reported that the shock brought down hundreds of tons of rock from the sea cliffs. The tremors continued in this central district of the seismic disturbance for a week or two after the principal shock, during which period over a hundred were felt.

The time data, though imperfect and to be taken as only approximately correct, are interesting. The official time at Adelaide was 2.25 m. 20 sec. p.m. The seismic wave reached Melbourne at 2.35 p.m. Adelaide time (3.35 p.m. Victorian time). The shock was felt almost simultaneously in a lineal direction between Port Wakefield and Port MacDonnell. This is proved by the official reports, received by the Postmaster-General (Sir Charles Todd) from his officers stationed between the two places named, showing only a variation of three minutes (2.25 p.m.—2.27 p.m.) in this distance. Port Augusta time was 2.30 p.m.

This agreement in time implies simultaneous movement in the earth's crust over a great distance, probably by settlement along the line of fissure which runs north and south and coincides generally with the great "rift" valley of Spencer Gulf and Lake Torrens. There is reason to believe there are two great lines of settlement in southern Australia. One running east and west in a line with Bass Strait;

and the other approximately at right angles to this, corresponding to the Great Central Valley of South Australia, which as has been shown, is a fault valley. In the analysis of South Australian earthquakes, given above, it will be seen that the greatest number of earth tremors occur on such a north and south line. A scale of intensity, known as the Rossi-Forel Scale, has been framed, which expresses in degrees, ascending from I. to X. the relative intensity of earthquakes, as judged by their effects. On comparison with this scale, the earthquake just described had an intensity at Kingston probably equal to No. IX., or next below the highest degree of intensity.

The second general earthquake, in the above list, occurred in a series of shocks covering the dates, September 19-24, 1902. Two were felt on September 19, at about 6.35 a.m. and 8.5 p.m. The last named was the most important of the series. The area affected was not quite so great as that on May 10, 1897, but extended from Port Augusta in the north, across to the River Murray on the east, the Mount Lofty Ranges, Yorke Peninsula, and the South East. Outside the State, a rumbling noise was heard and an earth tremor was felt at Tareena, western New South Wales, at 8.10 p.m. (8.40 p.m. New South Wales time) on the same day. (This place was also included in the great earthquake of 1897.) Also at Serviceton, Casterton, and Nhill, in western Victoria, and at the last-named the shock was timed at 8.40 p.m. (8.10 p.m. Adelaide time). The maximum of intensity appears to have been towards the southern end of St. Vincent Gulf. At Warooka, Yorke Peninsula, chimneys fell, walls were partially demolished, while few buildings escaped minor injuries. On the opposite side of the Gulf, at Normanville, Clarendon and other places, the

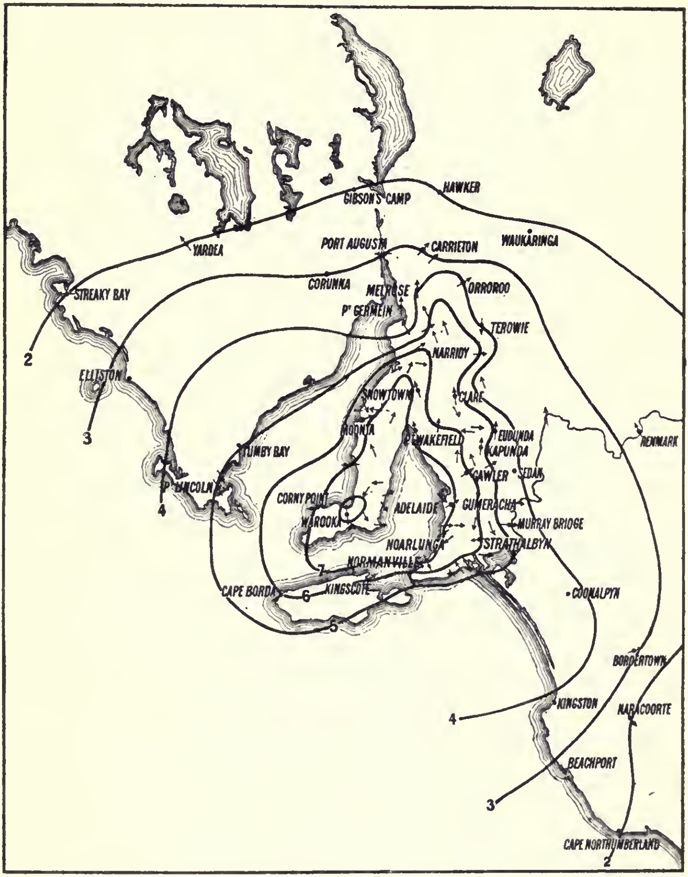


Fig. 45. Chart of Earthquake. 19th September, 1902. The concentric lines indicate areas of equal intensity. The arrows shew the direction in which the earth wave was travelling as felt by observers.

shock was scarcely less severe. The lanterns of Troubridge Lighthouse were completely destroyed, and the spilt oil, set fire to the wood-work of the building. This earthquake, as also the preceding one described, affected many wells and springs, closing some and opening others. Judged by the Rossi-Forel scale, the main shock may be rated at the VII. degree of intensity. The foci of the 1902 earthquake were situated further north than those of 1897, but in both cases evidently occurred in relation to the same zone of instability in the earth's crust. The later earthquake was felt more severely in Adelaide than the former, probably because the city was situated nearer to the epicentrum. Both earthquakes were accompanied by a rumbling sound, which either preceded or was concurrent with the sensible shock.

Mr. Griffiths, late Assistant Government Astronomer, at my request, kindly drew from data in the possession of the Adelaide Observatory, an isoseismic chart of this earthquake, which is reproduced in Fig. 45. The concentric lines are drawn through places which experienced the shock of equal intensity, and the arrows show the direction in which the earth wave was travelling, as felt by observers. From the nature of the evidence, the lines must be taken as only approximately correct. The lineal character of the shock is clearly shown by the chart, as well as its direction being along the line of the supposed great-fault plane of the Central Valley of South Australia.

CHAPTER VIII.—METEOROLOGY AND CLIMATE.

(*a.*) The **meteorological conditions** of South Australia form part of a larger system which includes the whole continent. Australia consists of immense plains, in its inland portions, with its highlands chiefly arranged near the coasts. The coastal ranges act as barriers to the aqueous currents in their passage inland, causing plentiful coastal rains over a more or less restricted zone, and a very limited rainfall over the inland plains. The dryness of the interior is further promoted through being geographically situated within the anticyclonic, or "dry-belt" latitudes, caused by the south-east trade winds; and also by the presence of great basins of inland drainage and saline deposits, which produce a bare and arid surface. The geographical position of the settled portions of South Australia brings this State into closer proximity to these arid conditions than other parts of Australia, and the climate is correspondingly influenced by them.

(*b.*) The **climate** of South Australia varies greatly both with respect to elevation and latitude. The hills and elevated plateaus have a genial climate, bracing but not severe, in winter; warm in summer, during the day, but usually cool at night with refreshing dews. The plains bordering the sea have the advantage of a prevailing wind from the south-west, which, as a cool sea breeze, moderates the heat of summer. The South East district is moist and temperate. The interior is under the influence of continental conditions, with greater contrasts in the seasons—intense heat in summer, with a corresponding intense cold caused by the great radiation which takes place on winter nights.

(*c.*) The **Seasons.**—The Australian year cannot be sharply divided off into four seasons. As compared with colder temperate latitudes, Australia has no winter, and autumn is only marked by the ingathering of the fruits. The year is practically divided into two seasons, Spring and Summer. The so-called "Winter" is the period of awakened life, bringing growth and greenness over the face of nature, and passes somewhat suddenly into Summer. The five months, from November to March, may be regarded as summer months; and the remainder of the year is best characterised as a delightful blending of sunshine and showers. Slight frosts occur during the so-called "winter months," especially in the hills, with hoar-frosts on the plains. Snow never falls on the plains, and but rarely on the highest points of the ranges, from which it quickly disappears on the rising of the sun.

(*d.*) **Barometrical Readings.**—As in the case of all continental lands, the tendency is for the barometer to stand at "high" over the centre of Australia. This is most marked during the winter months when the sun is north of the equator and central Australia is more directly under the influence of the descending currents of air, which prevail on both sides of the equator just outside the tropics. This down draught of air is made apparent by the high readings of the barometer, the intense cold at night, and the presence of the south-east trade winds in the north, and the anti-trades in the southern portions of the State. As a descending current of air is necessarily dry, it seldom rains in Central Australia during the winter months. The southern coast, however, comes more or less under the influence of the belt of low atmospheric pressure over the Southern Ocean. This belt of low pressure is the path along which the cyclonic storms travel, and in their progress, from west to east, overlap the coastal districts and supply the winter rains. The alternate passage along our southern coast of cyclonic, or areas of low pressure; and anti-cyclonic, or areas of high pressure, may be compared to waves of the sea, the cyclone representing the trough of the wave, and the anti-cyclone, the crest of the wave—the former reading 'low'' and the latter reading ''high'' by the barometer. During the summer months, with the sun vertical over the northern portions of Australia, the great heat of the ground reverses the atmospheric circulation, causing it to rise, like hot air in a chimney. A surface current is then drawn in from the Indian Ocean, heavily charged with vapour, to supply the place of the rising column of hot air, and forms the **monsoon**, which brings tropical rains over the northern portions of the continent.

When the monsoonal ''low'' becomes developed over northern Australia, it has the effect of pushing the belt of high pressure towards the southern sea-board. It is the prevalence of relatively ''high'' barometers, together with the hot dry air which blows from the interior when a cyclonic storm is passing along the southern coast, which accounts for the dry summer in southern Australia. The storm centres generally pass the meridian of Adelaide to the south of Kangaroo Island, so that, in most cases, it is only the northern limb of the storm area that overlaps the land. This fact explains why the barometer at Adelaide does not generally give very low readings during the passage of a storm, and accounts for the prevailing calm weather enjoyed by the maritime districts of South Australia.

(*e.*) **Temperature.**—The extreme seasonal temperature, in the shade, at Adelaide and southern South Australia may be regarded as ranging between 32° F. and 114° F. The greatest cold occurs at night, associated with high barometers and calm, dry weather. The days of winter, apart from occasional storms of wind and rain, are bright and invigorating. In the uplands, frosts are more frequent and when the atmosphere is humid night fogs sometimes occur, but these generally lift soon after day-break. In the inland and central regions, the diurnal range of temperature is generally very great; often amounting to 40°-50°. Whilst the days are often decidedly warm in the winter season, the cold at night is sometimes sufficient to convert the contents of the water-bag into a solid mass of ice. In Mr. David Lindsay's Journal of the Elder Scientific Exploring Expedition, 1891-2, which crossed the plateau between the Peake and Western Australian borders, there is given a maximum day temperature of about 60°-70° F. and a minimum night temperature generally below freezing, sometimes as low as eight or ten degrees of frost. This was in the months of June and July.

The summer months are characterised by alternations of hot and cool spells of weather. A low barometric centre off the southern coast has the effect of drawing in surface air currents from the interior. These passing over the heated northern plains, become fiercely hot, giving rise to hot winds and dust storms, which, whilst they last, produce a sense of great

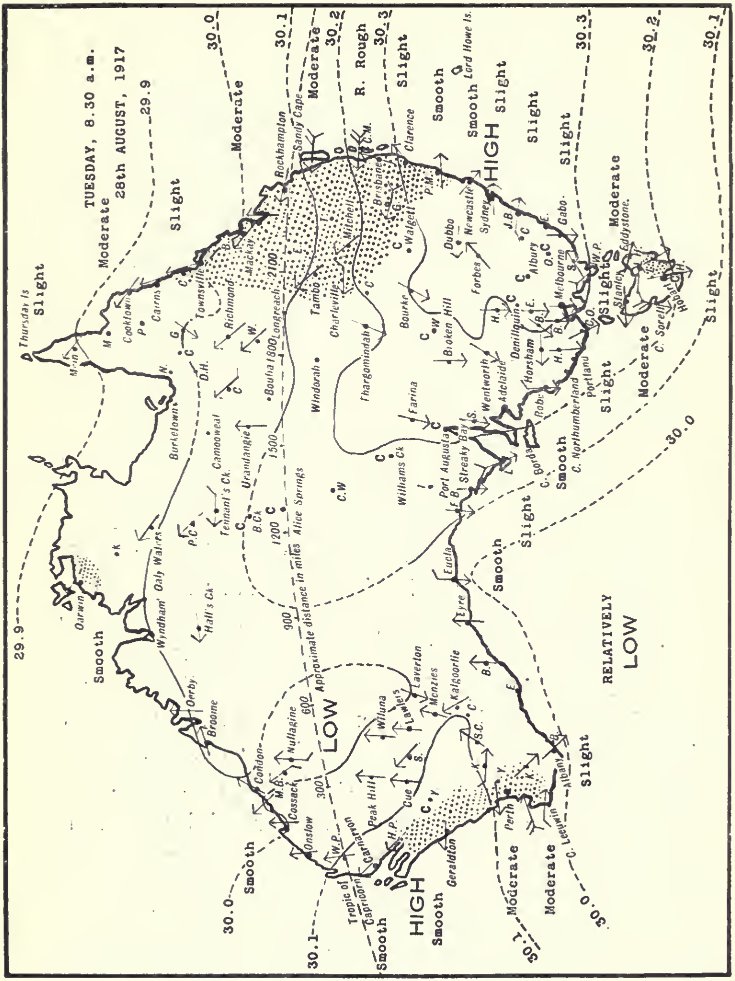


Fig. 45a. Weather Chart of Australia, 28th August, 1917. (C = calm. The shaded areas are those in which rain fell. Note the isobars).

lassitude and discomfort. As the cyclonic disturbance passes a given meridian, the wind swings round to the west, producing a violent dust storm, and a rapid fall of temperature which may amount to 30° or 40° in a few hours. The days on which the thermometer rises to 100° F. or over, are, in most years, comparatively few and the extreme heat of brief duration. The heat is very dry, and does not produce the same sense of exhaustion that a corresponding temperature would in a moister atmosphere. The maximum summer temperature of the hills ranges about 10° lower than that of the plains, and the close proximity of these highlands to Adelaide, places the city in a most advantageous position, in that it possesses a cool retreat which can be reached in less than an hour by either horse or rail. The climate of South Australia, on the whole, is one of the most salubrious and enjoyable that can be found in any part of the world.

(*f.*) **Rainfall.**—South Australia receives its rain in the first instance, chiefly from the Indian Ocean. The aqueous vapour produced by a copious evaporation in warm latitudes, develops into cyclonic centres of low pressure and follow two main drifts, passing from west to east. One of these belts of low pressure skirts the south coast, supplying the winter rains; and the other follows the north coast, and supplies the monsoonal or summer rains. The rains of the south coast are heaviest on the Mount Lofty ranges, the southern Flinders ranges, and the South East. They are usually light on the West Coast and the Murray Plains, and do not, as a rule, extend much further inland than the head of Spencer Gulf. The indications for rain are, cirrus clouds with warm currents of air setting in from the east and north. These warm currents generally absorb the aqueous vapour and prevent precipitation on the advancing side of the cyclonic disturbance. When the storm centre has passed and the wind veers round to the west, the cooler conditions permit condensation, the clouds reappear, and rain ordinarily follows. There are often several cyclonic centres following one another along the Southern Ocean in quick succession. This is indicated by the backing of the wind to the north and north-east, with a temporary spell of fine weather which may last twelve or twenty-four hours and is followed by more rain. The anticyclone is the prevailing atmospheric condition over South Australia, and as the storm centre is bounded by such "high" centres on either side, it is almost invariably nipped into a V-shaped trough which limits its area and intensity (Fig. 45a). The "early rains" usually set in about April, and the "latter rains" usually thin off in September. June is the wettest month of the year for the south.

The southerly extension of the land, forming the Victorian and Tasmanian peninsula, often acts as a buffer to the cyclonic disturbance, especially if a "high" centre has formed over Victoria. This may have the effect of retarding the passage of the storm in the neighbourhod of Adelaide and, in summer, prolonging the heat wave; or the high pressure to the east shunts the storm centre off the land (which often happens in winter), and as a consequence the forecast of rain fails, with the disappointing notice from the meteorological office that the storm has "gone south." At other times the "low," bringing rain, meets with another storm centre in Bass Straits, with the effect that the union of the two storm centres widens out the atmospheric disturbance and throws back the isobars

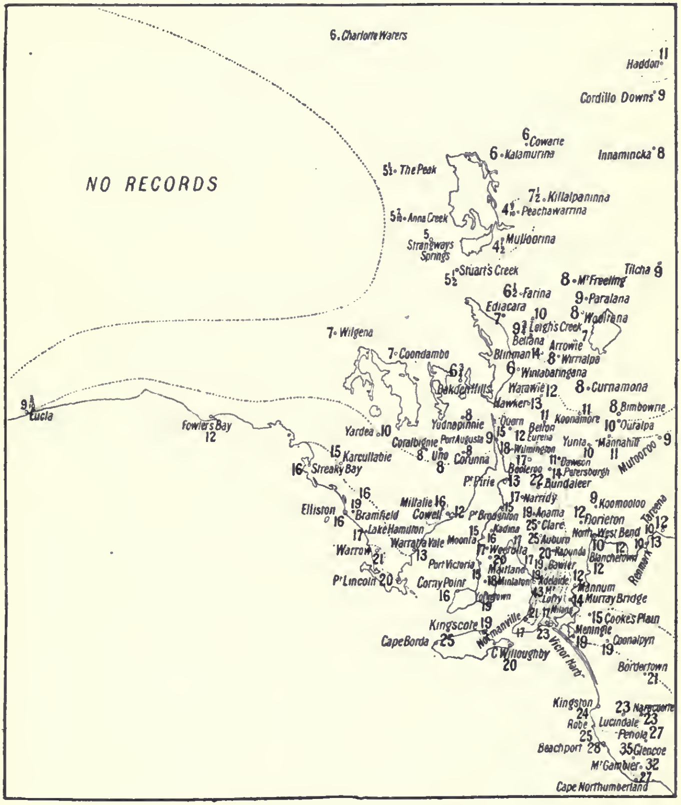


Fig. 46. Map of Average Rainfall.

in a westerly direction. When this occurs the Murray Flats and eastern slopes of the Mount Lofty ranges get supplementary rains which often extend back as far as Adelaide.

The summer, or tropical rains, have been explained under "Barometrical Readings." Were it not for the monsoons, the central portions of Australia would be a vast rainless area. As it is, the rain is often fitful and very limited, the annual rainfall of the driest portions ranging from *nil* to ten or twelve inches, according to the season, with an average of from five to six inches. The rainfall of the northern and central regions is almost exclusively electrical and torrential in its character, and it soon disappears in the arid sands. The monsoonal depressions develop on the north-west quadrant of the continent and form a loop penetrating southwards. If such a loop from the north corresponds in time with a low centre passing along the southern coast, they may unite to form a monsoonal "trough" across the continent, which supplies conditions very favourable for rain. The thunderstorms which visit Adelaide, and the south generally, are usually caused by an extension of a monsoonal depression of this kind. Taking the south as a whole, 20 to 25 per cent. of the annual fall occurs in the summer, and the remaining 80 to 75 per cent. in the winter. (Fig. 46.)

With the exception of the first two years after the founding of South Australia, a continuous record of rainfall in Adelaide has been kept. The average during the 77 years to the end of 1915 has been 20·85 inches. The wettest year (1889) during this time gave 30·87 inches; and the driest year (1914), 11·38 inches.

Chapter IX.—THE FLORA OF SOUTH AUSTRALIA.

In the forest flora of South Australia the two dominant genera are *Eucalyptus* and *Acacia*, which have a very wide distribution, although often locally restricted as to species. This is true of the flora generally, as the strongly contrasted physical conditions in different parts of the country occasion sharply defined boundaries for most of the plant life. There are three well marked floras: (*a*) of the Hills; (*b*) of the Sandy Scrub Lands; (*c*) of the Northern Plains (Desert Flora).

(*a*) **The Hills** include most of the forest country. The **Eucalypti,** somewhat inappropriately called "gum trees," are represented in extra-tropical South Australia by thirty-four species and form the characteristic forest features. The more common species follow. *Eucalyptus rostrata* (Red Gum or River Gum) is much used for posts, sleepers, building purposes and jetty piles. *E. leucoxylon* (Blue Gum) is valued for its superior qualities for making naves, felloes, and other articles made by wheelwrights, and is also used for sleepers, posts, piles, and telegraph poles. *E. viminalis* (Manna Gum) is used mainly for firewood. *E. odorata* (Peppermint Gum) is a useful timber and good firewood. *E. fasciculosa* (Pink Gum) yields good timber. The above often grow in company on the foot hills, along creeks, and on plains where plenty of moisture exists in the subsoil; they attain a large size and are often scattered in park-like scenery. *E. obliqua* and *E.*

capitellata form together the Stringy Bark trees, very characteristic of the summits of our highest hills where there is a sandy sub-soil. The trees grow close together and run up straight trunks to a great height, forming a dense forest; and are used for scaffold poles, split palings, fencing rails and shingles. *E. corynocalyx* (Sugar Gum) grows principally in the Southern Flinders ranges, Port Lincoln, and Kangaroo Island. It is a hardy and useful tree and has been extensively planted and distributed by the Forest Department. It is used for poles, mining timber, and fencing posts.

The genus **Acacia** is represented by eighty-four species, one or more of which have found a habitat under all the varied climatic conditions of the country. In the moist hills we find *A. pycnantha* (the Broad-leaved or Golden Wattle), cultivated for its bark, which is rich in tannin, and for its gum which is of commercial value; *A. retinodes* (the Silver Wattle); *A. melanoxylon* (Blackwood), used for cabinet work; and *A. decurrens* (Black Wattle). The acacias of Australia show a remarkable modification of structure, in adaptation to a hot, dry climate by the absence of true leaves, which are replaced by a flattening of the stalk into a broad leaf-like expansion with a thick epidermis. Both eucalypts and wattles, in some of their species, show a modification of foliage in their passage from the young to the mature stage.

Casuarina stricta (Sheaoak) is also a very characteristic tree of wide distribution, and sometimes forms half the trees of a district. It grows on sandy subsoil, and has graceful filamentous foliage which is a useful fodder when grass is scarce.

Many smaller trees and shrubs constitute the undergrowth, including, *Leptospermum myrsinoides, L. scoparium,* and *L. lanigerum* (Tea-trees), which in spring are covered with white bloom; *Banksia marginata* (Honeysuckle Tree), with its large and showy flowers; *Exocarpus cupressiformis* (Native Cherry), an elegant shrub which carries the fruit-stone outside the berry (which is really the swollen fruit stalk). The *Hakeas* form a characteristic group amongst which *Hakea rostrata,* with large curved fruits; *H. rugosa,* with small pointed fruit; and *H. ulicina,* with its small white flowers, are very common in the hills. *Acrotriche depressa* (the Native Currant) occurs in heath country and bears a sweet edible berry. *Astroloma humifusum* (the Native Cranberry), another dwarf prickly-leaved shrub, inhabits hillsides and gullies. *Kunzea pomifera,* growing in sandy places and often near the sea, bears a very small "apple," which is used for making tarts. Other genera are *Cassia* and *Grevillea* and various dwarf species of Acacia. A striking feature is given to the landscape in places by the *Xanthorrhoea* (or Grass Tree). *X. quadrangulata* grows on rocky ledges and forms a trunk 5 or 6 feet in height, with flower stalk 3 to 6 ft. and is of extremely slow growth. *X. semiplana* is trunkless, and grows on lower ground in sandy soil. *X. Tateana* grows a trunk up to 15 feet high and flower spikes up to 20 feet; it is very common on Kangaroo Island, where it has been largely destroyed to obtain from it the so-called "gum," or more correctly resin, which contains nitro-picric acid, used in the manufacture of explosives, and also a valuable dye. This resinous substance, mixed with clay, is used by the aborigines in some parts to form the handles of their knives, &c. The parasitic plant, *Loranthus exocarpi* (Australian Mistletoe), with its bright red flowers, is often seen growing pendant on Casuarinas, Eucalypti, and other trees.

The virgin ground of the hills, in spring time, produces a diversity of flowers which often makes a brilliant display of colour. The showy *Epacris impressa* (Australian Heath), covers extensive areas. The feathery *Clematis microphylla,* is a striking plant; as is also *Grevillea lavandulacea* with its delicate pink and wax-like flowers. On light soils the "Everlastings" belonging to several genera, are often in great profusion; amongst these *Helichrysum apiculatum,* with its yellow flowers is very common on the foot-hills of the ranges, and *H. Blandowskianum,* with white flowers and soft, woolly leaves, is a feature in the sandy country of the South-East. *H. bracteatum,* perhaps the most beautiful of the "everlastings," is found in the hills and extends to the Far North. The recumbent *Kennedya prostrata,* known as the "Scarlet Creeper," running many feet along the ground, attracts the eye by its bright scarlet, pea-like flowers. The modest *Drosera Whittakerii* (Sundew), with its white flower and reddish foliage close to the ground, grows abundantly on grassy banks. Its leaves are covered with hair-like glands which exude a sticky substance, to catch small insects, as it is of carnivorous habit. Some of the choicest examples of floral beauty will be found in the **Orchids**, which form not only a large family, including 19 genera and 77 species known in South Australia, but exhibit a marvellous variety of form. Among the commoner species will be found *Caladenia Patersoni* (the Spider Orchid), *Pterostylis longifolia* (the Bird Head Orchid), and in sandy soils, *Diuris longifolia.*

The **Ferns** (Filices), are mostly confined to the moist situations of the hills. The cosmopolitan species, *Pteris aquilina* (Bracken), is abundant in many parts of the State; the *Adiantum æthiopicum* (Maiden Hair Fern), is common in sheltered places in the hills; *Todea barbara,* forms a short trunk, like the Tree Fern, with fronds six feet long; *Gleichenia circinata* (Coral Fern), grows in very wet places; *Cheilanthes tenuifolia* (Meadow Fern), is common under the shelter of rocks and in grass land on the hills. It extends to favoured spots in the farthest north, as do also *Notholæna vellea* and *Grammitis, Reynoldsii,* small hairy ferns.

(*b.*) The **sandy** and **limestone Scrub Lands** include the Murray Flats, the Ninety Mile "Desert," much of the South-East, Kangaroo Island, Yorke Peninsula, and most of the west Coast. The arboreal flora of these districts maintains a general sameness, and is characterised by stunted trees with close undergrowth which often makes a very dense scrub. There is a considerable commingling of species between the moister parts of the Mount Lofty Ranges and the cool moist districts of Kangaroo Island and the South-East. As a rule the genera are represented by species of a more dwarfed character than their congeners of the hills. Thus the Eucalypti are for the most part dwarf varieties, generally classed under the name "Mallee," such as *E. dumosa, E. oleosa, E. gracilis, E. incrassata,* &c., which possess the peculiar feature of having the trunk growing underground and the branches shooting from the surface of the ground. *E. bicolor,* or Murray Box, is common along the Murray and its lagoons. *Casuarina distyla,* is the Scrub Sheaoak, eight to ten feet high. *Banksia ornata* is the saw-leaved Scrub Honeysuckle, and is often accompanied by *B. marginata. Fusanus acuminatus,* the Native Peach, forms a succulent fruit with a hard seed stone called "quondong." The Sandalwood (*Santalum lanceolatum*), occurs in the west central parts of the State, and has a pleasant aroma when freshly cut. The *Myoporum platycarpum,* of the Murray and Yorke Peninsula, is also commonly called "Sandalwood," and supplies good sheep fodder. *Xanthorrhoea semiplana* often occurs in countless numbers, as in the Ninety Mile Desert. The Tea-Trees (*Melaleuca* and *Leptospermum*) select moist situations, and the Native Pines, *Callitris robusta* (the Murray Pine, very widely distributed), *C. cupressiformis,* and other species, grow on sandy ridges, but the wood is of little value.

(*c.*) **The Northern Plains,** with which may be included the northern parts of the Flinders Ranges, are deficient in moisture, and the flora may be regarded as of a sub-desert character. Some of the southern Eucalypti, as the red and white gums, follow the creeks and penetrate far into the north. The most characteristic large-sized tree in the northern arid districts is the "Swamp Box," *Eucalyptus microtheca,* which lines the creeks, or makes "box flats" in the line of flood waters. *E. terminalis* (Bloodwood), and *Casuarina Decaisneana* (Desert Oak) are also fair-sized trees of the dry north. For the rest, the northern plains can boast of little more than open scrub country, with the hardier varieties of Acacia, such as *A. sentis,* an ornamental shrub, and *A. stenophylla, A. brachystachya, A. cyperophylla,* and *A. aneura* (these three are "Mulgas" and fodder trees); and *A. Cambadgei,* known as Gidya or Stinking Acacia. Where the climate is not too arid the long-leaved, broom-like, *Eremophila longifolia,* flourishes, as well as several *Hakeas,* of which *H. leucoptera* (Needlebush) has a wide distribution, and the Sheep Bush (*Geijera parvifolia*). *Ficus platypoda* (the Native Fig) grows among the rocks of the Everard Range.

Still more characteristic of the dry areas are the undergrowths, some of which are valuable fodder plants of the interior, such as the Salt-bush (*Atriplex nummularium*) and others; the Blue-bush (Fig. 47) (*Kochia sedifolia*) and others; the Cotton-bush (*K. aphylla*), and the Buck-bush. Tussocks of the needle-leaved *Triodia irritans* (Porcupine Grass), and *Spinifex paradoxus,* a sand-binding grass, are sure to arrest the attention of the traveller. On the sandhills grow a great variety of native grasses and other annuals which spring up rapidly after rains, such as the wild Geranium and the succulent *Portulaca oleracea,* and *Calandrinia balcnnensis,* called by the natives "Parakeelya." The latter has bright pink flowers and its fleshy leaves are so succulent that cattle can live on them for weeks without requiring a drink. The gorgeous red and black flowers of "Sturt's Pea" (*Clianthus Dampieri*) make a striking feature over wide areas in the sandy country of the interior, and about Cooper Creek the

Stuart Pea (*Crotalaria Cunninghamii*), with its large golden and green flowers, is almost equally remarkable. The various species of *Cassia*, with their masses of yellow bloom, brighten the aspect of the desert.

CHAPTER X.—THE VERTEBRATE FAUNA OF SOUTH AUSTRALIA.

MAMMALIA.

Australasia forms a zoological region which is sharply differentiated from all other parts of the world. This is particularly the case with respect to the Mammalia, which are of primitive and ancestral types. With the exception of a few cosmopolitan forms such as bats, rats, mice, and the wild dog (Dingo), the terrestrial mammals of other parts of the world are entirely absent from the Australian Continent. On the other hand, the Marsupialia or pouched mammals, which are only represented in other parts of the world by the family of true Opossums and rat-like *Caenolestes* of America, constitute, with the Monotremata, the characteristic mammalian life of Australia.

The Mammalia are divided into two main divisions, with three sub-classes:—

Div. I. The placental mammals :	Sub-class 1. True mammals, such as the horse, lion, mouse, etc.
Div. II. The non-placental mammals	Sub-class 2. Marsupialia (pouched), kangaroo, wombat, opossum &c. Sub-class 3. Monotremata (rudimentary pouch and with single vent), platypus and echidna.

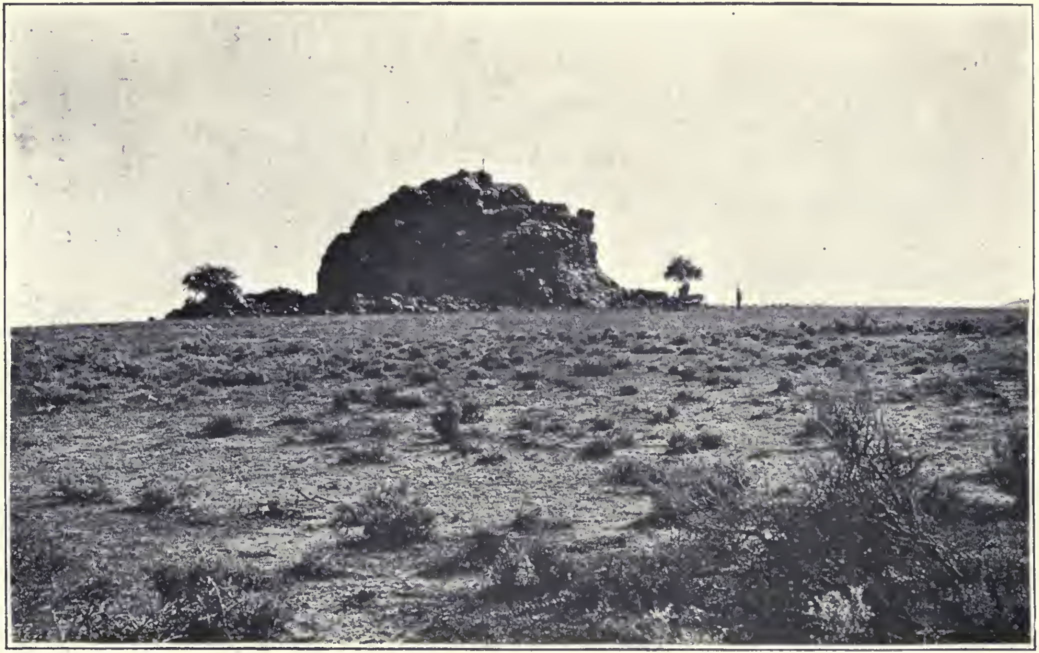


Photo. D. Mawson.

Fig. 47. A Butte or Block of Cambrian Limestone and Ironstone, known as Elder's Rock, near Paratoo Station, on the Broken Hill Railway line. The vegetation consists of Blue-bush and Salt-bush, which are characteristic of the drier parts of the State.

The placental, or true mammals, bring forth their young in a perfect form, and at birth are usually sufficiently developed to use their limbs and find their food, as required, from their mother's milk. The non-placental mammals are born at an early stage, when they are very small and undeveloped, requiring protection in the maternal pouch, where they are placed by the doe, and where, for a considerable period they adhere to the nipple: on this account they have received the name of Marsupials. They, no doubt, represent one of the early stages in the development of the Mammalia, as the remains of small marsupials are found in the Mesozoic division of rocks long before the true mammals came upon the scene. In larger continents the forces operating towards modification of form were relatively more powerful and rapid in their action, leading up to the higher type, whilst in the isolated and more stationary continent of Australia, the struggle was less severe, so that whilst the primitive type of the Marsupialia increased in size and diversity, they failed to reach a higher organic type. The Dingo has an ancient record on Australian soil, as its bones are found with those of the extinct marsupials, but there is little doubt he is a comparatively late introduction, probably through the agency of man.

MARSUPIALIA.

Marsupials are divided into two sections—(A.) The Diprotodontia, which possess only a single pair of incisor teeth in the lower jaw. (B.) the Polyprotodontia, in which the lower incisors number more than two.

A.—Diprotodonts.

The **Kangaroos** and **Wallabies** (*Macropus*) are a very distinct group, marked by their short fore-legs, and very long and powerful hind-legs used for progression by leaping. The larger species can jump nearly thirty feet at each bound. The tail is thick and strong, and with the hind feet, acts as a tripod, to give steadiness to the animal in an upright position, and also as a balance to the rest of the body when in movement. The South Australian species include the Great Grey Kangaroo (*M. giganteus*); the Great Kangaroo of Kangaroo Island (*M. giganteus*, var. *fuliginosus*), which was at the point of extinction when the South Australian Government protected it; the Great Red Kangaroo (*M. rufus*), the largest of the group; and the Euro (*M. robustus*, var. *erubescens*), which is still moderately common in the Flinders Ranges. The **Wallabies** include the Dama (*M. eugenii*), or common scrub Wallaby, which is still common both on the mainland and Kangaroo Island; Toolache (*M. greyi*), and Bush-tailed Wallaby (*M. ruficollis*) occurring in the south-east; the Rock Wallaby (*Petrogale xanthopus*) is common in the rocky ranges. Smaller forms of allied genera are the Nail-tailed Wallabies (*Onychogale*), distinguished by a horny and nail-like tip to the tail; *Lagorchestes*, or Hare-wallaby, so named from some likeness in form and habits to the hare, occurs in the north. The **Rat-Kangaroos**, in one genus, of which (*Potorous*), the animals do not leap but run on their four legs; whilst another species (*Bettongia penicillata*), lives in burrows and has a prehensile tail used for carrying tufts of grass.

A second family of the Diprotodontia is that of the **Phalangeridae**, so named from the phalanges, or toes of the foot, being united by a skin or web. They are arboreal in their habits, usually having prehensile tails; and some groups (the Flying Phalangers) possess folds of skin on each side, which, in leaping, expand like a parachute. This family includes the Australian "Opossums," the "Native Bear," the "Flying Squirrels," and several others. The Native Bear, or Koala (*Phascolarctus*), occurs in Victoria, close up to the South Australian borders, but its existence in South Australia is doubtful. The true Opossums (*Didelphys*) are confined to America, but the Australian "Opossums," so-called, belong to a distinct family. In South Australia there are two, the Common Opossum (*Trichosurus vulpecula*), and the Ring-tailed Opossum (*Pseudochirus peregrinus*). The former is still fairly common, making its home in hollow branches of gum trees and browsing on leaves at night. The Flying Phalangers are found in Eastern Australia but do not occur in South Australia.

The third family of the Diprotodontia comprises the **Wombats** (*Phascolomys*), of which there are two species in South Australia, the Hairy-nosed Wombat (*P. latifrons*), which is only found in South Australia; and a larger, but less common species (*P. mitchelli*). The wombats make large burrows and live on roots.

B.—POLYPROTODONTIA.

Distinguished by the lower incisor teeth being more than two in number and possessing more or less well-developed canine teeth. This division includes the Bandicoots, Native Cats, Pouched Mice, &c.

The **Bandicoots** comprise a number of small marsupials which burrow in the ground and live on insects, worms, bulbs, roots, fallen berries, &c. The Common, or Short-nosed Bandicoot (*Perameles obesula*), is about twenty inches from nose to tip of tail. There are also the Banded-Bandicoot (*P. fasciata*), and the Long-eared Rabbit Bandicoot (*Peragale lagotis*), and others.

The **Native Cats** belong to the family of carnivorous marsupials, which includes the Tasmanian Wolf (*Thylacinus*), and the Tasmanian Devil (*Sarcophilus*), both of which are very ferocious and destructive to domestic fowls and sheep. In South Australia, fortunately, only some of the smaller species are found, and these are somewhat rare. The Common Native Cat (*Dasyurus viverrinus*), is variable in colour, spotted white, the tail excepted; and a larger species (*D. maculatus*), commonly known as the Tiger Cat, has a length of head and body of about 25 inches, and a tail, 19 inches long, both tail and body being spotted.

In the same group are a number of smaller examples which go under the general name of **Pouched Mice,** such as the widely distributed Brush-tailed Pouched Mouse (*Phascogale penicillata*), so called from its tufted or brush-like tail; the Yellow-footed Pouched Mouse (*P. flavipes*), and the Common Pouched Mouse, (*Sminthopsis murina*), which is found throughout Australia south of the Tropics.

The discovery in 1888 of a **Marsupial Mole** (*Notoryctes typhlops*), supplies another curious instance of a marsupial exhibiting, in its external form and habits, a close resemblance to a non-marsupial mammal living in other parts of the world. It measures about six inches in length, is adapted for life underground, and burrows with extraordinary rapidity in sandy country. Its home is in Central Australia; most of the specimens obtained are from the Finke basin.

Monotremata.

Still lower in the scale of mammalian life than the marsupials proper, is a type which is so peculiar that its members are made a distinct Order, called the Monotremata. The name indicates that these animals have a single aperture at the back part of the body by which the waste products as well as the eggs are discharged. This is also the condition with birds and reptiles, which indeed the Monotremes resemble in many particulars. Like birds they lay eggs, and differ from all other mammals in that the mother has no milk teats, but the milk exudes through the skin and is forced into the mouth of the young by the contraction of certain muscles.

There are two very distinct types. **The Duck-bill Platypus** (*Ornithorhynchus anatinus*), is an aquatic animal, which, shaped like a mole, though with webbed feet, has the bill of a bird, is covered by hair like a mammal, and has some structures which resemble those of reptiles. It has a rudimentary pouch, but the female parent hatches its eggs by sitting on them like a bird, though its temperature is 20° F. lower than the true mammals. It is an expert swimmer, and makes long burrows in the banks of streams which it frequents. It is one of the most interesting and peculiar animals which at present exist on earth. It is found in all the Eastern States, Tasmania, and South Australia.

The second is the **Echidna** (*E. aculeata*), or Spiny Ant Eater, which is furnished with strong quills, like a porcupine, lives in burrows and feeds chiefly upon ants. It has five toes on each foot, and carries its eggs in a rudimentary pouch, hatching them by the heat of the body. A species in Tasmania has short spines, and is covered with hair, and another in New Guinea is also hairy, has three toes on each foot, and possesses a very long snout.

BIRDS—(AVES).

The birds of Australia number nearly 900 species, and include most of the Orders found elsewhere, but have strongly marked Australian characteristics. We can note only a few of the commoner South Australian forms.

(*a.*) The **Raptores**, or birds of prey, in South Australia are represented by numerous species, including Eagles, Falcons, Hawks, Kites, and Owls. The Wedge-tailed Eagle, or Eaglehawk (*Uroaetus audax*), is the largest of our birds of prey, and differs from other Eagles (*Aquila*), in the shape of its tail. With wings expanded it may measure eight feet across. It is widely distributed over southern Australia, is useful for destroying rabbits, etc., but is sometimes destructive to newly-born lambs. One of the commonest and most widely distributed is the Nankeen Kestrel (*Cerchneis cenchroides*). It is often erroneously called Sparrow-hawk. Although at times it catches birds, its chief food consists of mice, small reptiles, and insects. The Goshawk (*Astur approximans*) is very destructive to fowls. Several species of the true Falcons (*Falco*) occur. The nocturnal birds of prey, the Owls, are represented by the White Owl (*Strix flammea*), which is identical with the common Barn Owl of Europe, and a most useful bird for the destruction of rats and mice, etc.; and the Brown Owl, or Boobook (*Ninox boobook*), which has received its name from its call, which is very similar to that of the European Cuckoo. It is likewise a very useful bird.

(*b*.) The **Insessores**, include the very wide group of birds which perch when at rest and habitually live in trees. They usually have well developed wings and slender short legs. They are birds of gay plumage and their vocal powers often take the form of musical notes or song.

Australia is rich in Kingfishers, and none is better known than the Laughing Jackass (*Dacelo gigas*), with its quaint hilarious notes at early morn and evening. It is a characteristic bird of our woodlands, but does not go far from fresh water, for which reason it is not known on Yorke Peninsula. It is a useful bird in the destruction of small rodents, snakes, &c. The Piping Crow-Shrike, or "White-backed Magpie" (*Gymnorhina leuconota*), takes its popular name because its black and white plumage resembles that of the true Magpie of Europe. It has all the audacity of the Crow Family, has a sweet warbling note, is easily domesticated, and becomes an excellent mimic. The Crow (*Corvus coronoides*) is plentiful in scrub country, such as the Ninety Mile "Desert," near the sea shore, and in the dry north, where its melancholy wail adds to the depressing influence of the hot sandy plains. In the Interior it is represented by a smaller species, the Small-billed Crow (*Corvus bennetti*). Both are in ill favour from their habit of picking out the eyes of lambs and sheep when they are in feeble condition. The Honey-Eaters, the most characteristic family of the Australian region, are represented by about 90 species. They take their name from the habit of extracting honey from Eucalyptus and other flowers, with their brush-like tongue. They also feed on fruit, berries, and insects. To this family belong the Wattle Bird (*Acanthochaera carunculata*), and the White-bearded Honey-Eater (*Meliornis novae-hollandiae*) distinguished by white hair-like plumes on the throat.

The Cockatoos, Lorikeets, and Parrakeets, form one of the largest, as well as one of the most characteristic families of Australian birds, being represented by about 80 species. They exhibit great variety of brilliantly coloured plumage, sometimes associated with striking features, as in the Sulphur-Crested Cockatoo (*Cacatua galerita*), which has a movable crest, and is a very beautiful and intelligent bird. The quality of intelligence, indeed, is one possessed by the family as a whole, and makes them capable of being taught tricks and mimicry to a remarkable degree. They are ubiquitous in distribution, from the cool south to the northern central plains, and are often seen in flocks of several hundreds. The Lorrikeets possess brush-like tongues, by which they extract honey from flowers.

Several Cuckoos occur in our State. The Pallid Cuckoo (*Cacomantis pallidus*), and the Fan-tailed Cuckoo (*C. flabelliformis*), a smaller bird, are not uncommon; and all have the habit of their northern-hemisphere congeners of laying their eggs in other birds' nests. Other perchers are the Nightjars (*Caprimulgus*). The Frogmouth (*Podargus strigoides*), or Morepork, as it is often called in imitation of a call which it was formerly supposed to utter, but which is now generally conceded to come from the Boobook Owl; the Spotted Bower Bird (*Chlamydodera maculata*), which constructs not only a nest but a highly-ornamented playground; and the Red-breasted and Red-capped Robins, often seen on the Adelaide Plains. Amongst the Flycatchers, we have the familiar Black and White Fantail, or Willy-wagtail (*Rhipidura tricolor*), or as it is popularly known (probably from its familiar ways), the Shepherd's Companion. The bird has a curious habit of wagging its tail each time it alights. The Australian Finches (so called), include a score of species, some of which inhabit the dry interior, such as the Zebra Finch (*Taeniopygia castanotis*) or "Camel Sparrow," as it is often called, which is seen, in places, in immense flocks, generally near water-holes.

(*c*.) The **Rasores**, or scratchers, of which the domestic fowl is a typical example, are represented in Australia by Doves, Pigeons, Quails, and the Mound-Builders. Among the Pigeons may be mentioned the Common Bronzewing (*Phaps chalcoptera*), and the elegant Crested Pigeon (*Ocyphaps lophotes*), which is found not only in the lower north, but in the arid plains of the interior. Quails, of which there are several species, are plentiful on our plains and coast-sandhills. The Megapodes, or Mound-Builders, are a singular group. They do not sit upon their eggs, but bury them in mounds made by scraping together vegetable matter and soil; the heat that arises from the decomposition of this material answers the purpose of an incubator. In these mounds the eggs are laid and carefully arranged by the birds and covered up. The Mound-Builders have large powerful feet (hence their name of "Megapodes"), to fit them for this labour. Of these birds, South Australia has the Native Pheasant, or "Mallee Hen" (*Lipoa ocellata*), which constructs a mound two or three feet in height and with a circumference of thirty or forty feet. The Bustard, or popularly named Wild Turkey (*Eupodotis australis*), is one of Australia's largest flying birds. It frequents open country.

(*d.*) The **Grallatores**, or Waders, usually have long legs and necks and a long slender beak, adapting them for wading in shallow waters and picking up small fish, worms, shellfish, &c. The largest Australian species, which occurs all over Australia, is the Native Companion (*Antigone australasiana*); it stands over four feet high, and is a friendly bird, hence its popular name. The common White-Throated Heron (*Notophoyx novae-hollandiae*), the Plovers, Rails, Sandpipers, Curlews, and Snipes, are common in South Australia, and belong to this division.

(*e.*) The **Natatores**, or Swimmers, are birds of aquatic habits, and usually more at home on the water than on the land. The lakes at the mouth of the Murray, as well as the Coorong, are the home of countless numbers of these birds. Among these the Black Swan (*Chenopis atrata*) must take the first place. Two species of Goose, the Wild Duck (*Anas superciliosa*), Australian Teal (*Nettion gibberifrons*), and Musk Duck (*Biziura lobata*), are also common. The Australian Pelican (*Pelecanus conspicillatus*), a powerful bird with large yellow bill and pouch, is often seen on the lakes, in the Port Adelaide River, and other inlets; whilst various Gulls, Terns, Petrels, Cormorants or Shags (*Phalacrocorax*), and the Albatrosses (*Diomedea*), frequent our shores. The Mutton Birds, or Petrels, breed in burrows, and form very large colonies on some of the islands of our coast.

(*f*.) The **Cursores**, or Runners, have only rudimentary wings and cannot fly. They depend for safety on fleetness of foot, for which they are fitted by possessing long and powerful legs. The Emu (*Dromaeus novae-hollandiae*) is the only species, (for the Spotted Emu (*D. irroratus*), is only a variety of the same species), and is exclusively Australian. The Emu attains a height of seven feet, and is therefore nearly as tall as the ostrich. It lives on the plains bordering scrub lands, and owing to settlement has become comparatively rare. The spotted variety is characteristically West Australian, but is sometimes seen across the border.

REPTILIA.

Snakes (Ophidia). There are a little over twenty species of snakes known in South Australia, which, with the exception of the Carpet Snake (*Python variegata*) and two blind snakes, are venomous. Few

20 [illegible]

are deadly to man; the most dangerous are the Black Snake (*Pseudechis porphyriacus*), the Tiger Snake (*Notechis scutatus*), the Death Adder (*Acanthophis antarctica*), and the Brown Snake (*Demansia textilis*) which is the species most prone to enter human habitations.

Lizards (Lacertilia).—The largest form is the Goana, misnamed "Iguana," (*Varanus varius*), which has been found up to seven or eight feet in length, and has a wide distribution. The spotted Goana (*V. gouldi*) is the commonest species in the State. Other common forms are the Jew Lizard (*Amphibolurus barbatus*), which produces a dilation of the skin at the throat like a beard; the Sleepy Lizard (*Trachysaurus rugosus*), which has a short stumpy tail, and when disturbed opens a wide mouth showing a purple coloured tongue; and the Mountain Devil (*Moloch horridus*), about seven inches long, covered with warts and large, curved spines, which give it the striking appearance that has suggested both the popular and scientific names. It occurs in the northern portions of the State, in sandy country, and lives on ants.

Tortoises (Chelonia).—A tortoise with a carapace, or shell, nine inches in length, and a neck which can be extended for seven inches (*Chelodina longicollis*), is very common in the Murray and Diamantina, where it lays its eggs in sandy banks. A larger species (*Emydura macquariæ*) has a shell fifteen inches long and possesses a very long neck. It is fairly common in the rivers mentioned.

BATRACHIA.

These occupy an intermediate position between Reptiles and Fishes, and are sometimes called Amphibia, because at an early stage in their life history they live in water, breathing by gills, and at a later stage in air, breathing by lungs. This class includes the Frogs and Toads, of which there are eight or nine species known in South Australia.

Frogs.—The Common Marsh Frog (*Limnodynastes tasmaniensis*), is very common in creeks and keeps up a constant croaking on summer nights. The Australian Bull Frog (*L. dorsalis*), has a deep sonorous call, like the bass note of a stringed instrument. The Tree Frog (*Hyla adelaidensis*), has, like other tree frogs, suctional discs on its toes to assist it in climbing. The Golden Frog (*Hyla aurea*), takes its specific name from its metallic colours, but whilst classed with the tree frogs usually lives in the water. It is found in the River Murray and in the lakes at its mouth. The smallest frog we have is *Crinia signifera,* which is only an inch long, but utters a loud shrill note, and frequents damp valleys hiding under stones. In the dry central parts of Australia the Frogs store large quantities of water in their bodies and bury themselves in the mud, during periods of drought, but revive immediately on the fall of good rains. The only **Toad** known in South Australia (*Pseudophryne bibronii*), is a small species, and is of a dark colour and covered with warts on its upper parts.

FOSSIL REMAINS.

The animals which immediately preceded the existing faunas in Australia were closely related to those now living in the country. Many extinct forms have been obtained which show much larger species of existing animals, such as the Kangaroo and Wombats, and others which differ materially from all existing genera. Thus the *Thylacoleo*, commonly called the Marsupial Lion, was probably carnivorous. The *Diprotodon*, the largest of all known marsupials, was a massive wombat-like animal with some features of the Kangaroo. The remains of Diprotodons of several sizes and probably of more than one species are known, and are plentifully distributed over the river and lake deposits of Australia, in some of which, as in Lake Callabonna, a great number were bogged and entombed. From this lake the first complete skeleton of the Diprotodon was obtained and can be seen in the Adelaide Museum. In addition to the marsupials, gigantic birds of the Emu type are found, as well as some obscure forms, the relationships of which, at present, are not well understood.

Chapter XI.—REFERENCES TO LITERATURE.

PHYSICAL FEATURES.

Woods, J. E. Tenison—Geological Observations in South Australia, 8vo. Lond. 1862
Tate, Ralph—Anniversary Address. Philosophical Society of Adelaide, Transactions, vol. 2 1879
Wall, De la Poer—Manual of Physical Geography of Australia. Melb., Syd., & Ad. 1883
Woods, J. D.—The Province of South Australia, 8vo. Adelaide 1894
Lords Com. of Admiralty—Australian Directory, Vol. I., South coast. Lond. 1897

GREGORY, J. W.—Geography of Victoria. 8vo. Melb. and Christchurch 1903

BROWN, H. Y. L.—Geological Map of South Australia. Adelaide 1899

FAVENC, E.—The Physical Configuration of the Australian Continent. Syd. & Brisbane 1905

Valuable information will be found in the works of the early explorers—Flinders, Sturt, Eyre, and McDouall Stuart, enumerated in Chapter III. of Part I.

Parliamentary Papers by H. Y. L. Brown (Government Geologist), McDouall Stuart, Freeling, Goyder, Selwyn, Ulrich, Giles, Gosse, Winnecke, Woodward, Tietkins, and others. Govt. Printer, Adelaide

Elder Scientific Exploring Expedition, Royal Soc. S.A. (Vol. XVI.) and Roy. Geog. Soc. S.A. Adelaide 1893

Horn Expedition to Central Australia. Melbourne 1896

Papers published in Transactions of Royal Soc. S. Australia by Tate, Scoular, Howchin, Basedow, and others. Adelaide

Papers in Aus. Assoc. for Advancement of Science by R. Tate, (Vols. 1, 2, and 5) H. Y. L. Brown, (Vol. I.), C. H. Harris, (Vol. V.), and W. Howchin (Vol. XIV.).

HOWCHIN, W.—Geology of South Australia. Govt. Printer, Adelaide 1918

FLORA.

HARVEY, W. H.—Phycologia Australica; 5 vols. Lond. 1858-63

BENTHAM and VON MUELLER—Flora Australiensis, 7 vols. Lond. 1863-78

MUELLER, F. VON—Introduction to Botanic Teachings in the Schools of Victoria. Melb. 1877

———— Eucalyptographia. Decades 1-10. Melb. 1879-84

———— Inconography of Australian Species of *Acacia*, etc. Decades 1-13. Melbourne 1887-88

————Iconography of Australian Salsolaceous Plants. Decades 1-9. Melb. 1889

———— Systematic Census of Australian Plants. Melb. 1882-89

WOOLLS, W.—Contribution to the Flora of Australia. Sydney 1867

FITZGERALD, R. D.—Australian Orchids. Sydney, 1874, &c.

MAIDEN, J. H.—Useful Native Plants of Australia. Sydney 1889

Tate, R.—Handbook of the Flora of Extra-tropical South Australia. Adelaide 1890

Brown, J. E.—Forest Flora of South Australia, 7 parts. Adelaide, 1884-5

Schomburgk, R.—Parliamentary Paper No. 85 of 1875, on Colonial Timber; and No. 246 of 1877, on Australian Eucalypts.

——— The Flora of South Australia: in Harcus' South Australia. Ad. 1876

Warren, W. H.—Australian Timbers. Sydney 1892

Cooke, M. C.—Handbook of Australian Fungi. Lond. 1892

Numerous Papers on South Australian plants will be found in the Transactions of the Royal Society of S. Australia by R. Tate, F. von Mueller, J. H. Maiden, J. G. O. Tepper, S. Dixon, S. Smeaton, M. Koch, Dr. R. S. Rogers, J. M. Black, and others.

FAUNA

General:—

Aflalo, F. G.—Natural History of Australia. Melb. and Lond. 1896

Saville-Kent, W.—The Naturalist in Australia. Lond. 1897

Lucas & Le Souef.—The Animals of Australia. Melb. 1909

Mammalia:—

Gould, J.—Mammals of Australia, 3 vols. Lond. 1863

Krefft, G.—Mammals of Australia. Sydney 1871

Waterhouse, F. G.—List of Mammals, etc., in Harcus' South Australia. Adelaide 1876

Ogilby, J. D.—Catalogue of Australian Mammals. Sydney 1892

Lydekker, R.—Handbook of the Marsupialia and Monotremata. Lond. 1894

Aves:—

Gould, J.—Birds of Australia. 7 vols. Lond. 1848 1869

——— Handbook to Birds of Australia, 2 vols. Lond. 1865

Campbell, A. J.—Nests and Eggs of Australian Birds. Sheffield 1900

North, A. J.—Nests and Eggs of Birds found Breeding in Australia and Tasmania. Sydney 1901

——— Useful Birds of Southern Australia. Melb. and Sydney 1907

Hall, R.—A Key to the Birds of Australia and Tasmania, 2nd ed. Melb. and Lond. 1906

Mathews, G. M.—Birds of Australia. Lond. 1910

——— List of the Birds of Australia. Lond. 1913

Leach, J. A.—An Australian Bird Book. Christchurch and Melb. 1911

Reptilia:—

KREFFT, G.—Snakes of Australia.	Sydney	1869
WAITE, EDGAR R.—A Popular Account of Australian Snakes.	Sydney	1898

The Publications of the British Museum and the Transactions and Proceedings of the Royal Society of South Australia, contain much valuable information on Australian Fauna.

PART III.—POLITICAL AND COMMERCIAL.

CHAPTER I.—EARLY DAYS.

THE first difficulties of the young colony arose over questions concerning the land. Survey work went on more slowly than the influx of immigrants, and this led to delays on the one side and impatience on the other. The Imperial arrangement by which the Resident Commissioner (James Hurtle Fisher) held administrative power over the land, and was responsible only to a Board of Commissioners in London, led to further friction. **Captain Hindmarsh**, the first Governor of the Province, after about eighteen months of office, was recalled, the joint control of affairs was ended by abolishing the office of Resident Commissioner, and the Government of the colony was by a new Act of Parliament, vested in a Governor and a council of three or more persons appointed by the Sovereign in Council.

Colonel Gawler, who succeeded Captain Hindmarsh as Governor, in 1838, found the country in a difficult financial position. The population had increased to 3,680 souls, and for the most part was concentrated either in or near the town of Adelaide. Delay in getting land, speculation in land instead of cultivation by those who had secured blocks, want of employment in the community, and absence of money combined to precipitate a financial crisis. During the first two years of the colony's existence there was no public revenue. Driven to extremities, Governor Gawler instituted a rash and unconstitutional procedure which brought the Province to the brink of ruin. With an inadequate revenue he undertook extensive public works to give employment for those who had no land to cultivate. The revenue for the three years, 1839-41, produced £75,773, while the expenditure amounted to £357,615, making a deficit of £281,842. Governor Gawler attempted to draw on the Imperial Government for the payment of his bills, but as this was contrary to the conditions under which the Province had been founded, his bills were returned dishonoured. The effect was disastrous and led to the financial ruin of many. Colonel Gawler was superseded in his office of Governor by **Captain George Grey,** in May, 1841, and the financial crisis was tided over by means of a loan from the British Parliament, which was subsequently remitted and written off as a gift.

Governor Grey's first effort was to place the finances of the country on a sound basis. A policy of rigid retrenchment was put in force. This, though causing loud cries of dissatisfaction and even threats, was in the end the best for the country, as it compelled those idling in Adelaide to go on to the land and open up the country.

During the four years (1841-5) in which Grey was Governor of the Province the population increased from 14,562 to 21,759, but throughout his term of office the ordinary revenue was inadequate to meet the costs of government, and the deficiencies had to be met by appropriating a portion of the revenue received by sale of land, a proceeding which had been authorised by an amending Act of Parliament.

An event took place in 1838 which demonstrated the practicability of occupying the interior of the country. Joseph Hawdon brought overland from Sydney a herd of cattle and horses, to the number of 335, in good condition. The event was celebrated in Adelaide by a public dinner. Three months later, E. J. Eyre, who had started before Hawdon, but travelled by a different route, also brought 300 head of cattle overland, and was followed by Captain Sturt with a herd of 400. This was the beginning of the important overland cattle trade which has been maintained ever since between South Australia and the western districts of the eastern States.

About 1845 the financial position of the colony began to show a decided improvement and a period of prosperity began. This was attributable to the increased development of the natural resources of the country. In 1842 the Kapunda copper deposits were discovered, and this was followed in 1845 by the discovery of the still more important Burra Burra Mine, whilst the amount of land under cultivation and pasturage was increased year by year.

In 1851, the great gold discoveries in New South Wales and Victoria produced temporarily a profound depression in the commercial condition of South

Australia. Nearly all the able-bodied men left for the diggings. The banks were severely taxed to find the coin required to meet the withdrawals, trade was at a standstill, and the Government offices were almost depleted of their staff. Many South Australians were very successful at the diggings, but the means of communication between the colonies at that time was uncertain and the gold miners found it difficult to forward remittances to their families in Adelaide. This led to a series of gold escorts, the first of which was under the charge of Tolmer, the Chief Inspector of Mounted Police; and was continued fortnightly for many months. Through the exigencies of the case, the Governor (**Sir Henry Young**), exceeded his powers by permitting a "Bullion Act" to pass through Parliament, by which, for one year only, gold dust, converted into ingots and tokens, was circulated as a legal tender. Many of the gold diggers on their return to South Australia had substantial sums to their credit, and invested their money in land, which led to a great development of the agricultural industries.

The relationship between the early settlers and the aborigines of the country was, on the whole, of an amicable nature. The tribes of the south coast, for the most part, exhibited a mild and tractable disposition and soon entered into friendly intercourse with the new comers. The only serious trouble with the natives occurred with the powerful and aggressive tribes of the Narrinyeri, who occupied the lower Murray and the Coorong. In 1840, the brig *Maria* was wrecked near the southern end of the Coorong, and the crew and passengers (probably numbering from twenty to twenty-five persons), were treacherously murdered by the natives, while the latter were pretending to guide them to the whaling settlement at Encounter Bay. The mutilated remains of seventeen persons were subsequently discovered. A strong party, under the command of Major O'Halloran, the Commissioner of Police, was sent to the scene of the murder to investigate the circumstances and punish the guilty parties. By the aid of friendly natives, two of the ringleaders were secured and hanged in the presence of a large number of their tribe, who were compulsorily detained to witness the execution.

About nine months later an attack was made by natives, near the North West Bend on Mr. Inman and party, who were travelling overland with 7,000 sheep. Two men were badly wounded and the sheep were carried off by the natives. This was followed by other onslaughts and seizures of stock, until the route was considered unsafe to travel on account of the number and warlike attitude of the blacks. A police party, under Inspector Shaw, while going to meet a company in charge of travelling stock, came into collision with a great number of natives, and in self-defence was compelled to fire upon them, killing thirty and wounding ten. This event was made a matter of official investigation in Adelaide, and though the police were exonerated from blame, it was felt that a more satisfactory method of coming to an understanding with the natives should be attempted. **E. J. Eyre**, who had distinguished himself as a bushman and explorer, was appointed Protector of Aborigines, and took up his residence on the Murray, where, living in touch with the principal tribes he secured their confidence and established such friendly relations that no further raiding was perpetrated.

CHAPTER II.—EXPLORATIONS AND SETTLEMENT. (Fig. 48.)

While the first colonists were gradually extending the line of occupation along the Adelaide Plains, heroic efforts were made to explore the great unknown land which surrounded them. To the first settlers, the Mount Lofty Ranges, covered with dense forests and thick undergrowth, enclosed the plains on their eastern side and offered a formidable barrier in that direction. The exploration of these ranges, the discovery of the Inman and Hindmarsh Rivers, and the penetration of the upland plains to the north of Adelaide, were accomplished during the first few years of the Colony's existence.

In no part of Australia was the work of the explorer so difficult and so fraught with danger, as in the great arid sand-wastes of the northern portions of South Australia. In May, 1839, **E. J. Eyre**, who was destined to perform some of the most trying feats in exploration, struck north, and discovered the Hutt, Hill, Broughton, and Rocky Rivers. Following up the southern Flinders Range, he discovered and named Mount Remarkable. He reached Mount Arden, and from its neighbourhood saw a great sheet of water to the west and north-west, which he named Lake Torrens, and travelled as far north as a hill that was subsequently called Mount Eyre. In the same year Eyre explored the country to the west of Port Lincoln, and penetrated to within about 50 miles of the western limits of South Australia. To save his life he was then compelled to return to his base at Streaky Bay. From the latter he took an easterly course, crossed the northern portions of Eyre Peninsula over the Gawler Ranges (which he named), and examined, still further, the country at the northern end of Spencer Gulf.

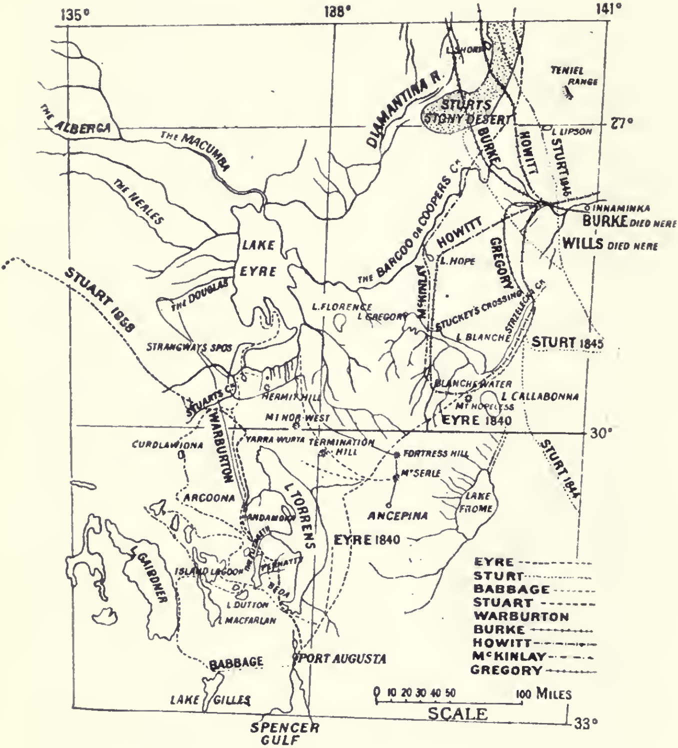


Fig. 48. Map shewing the Tracks of Explorers in South Australia.

In 1840 Eyre made another attempt to force his way into Central Australia. He had twice before made his camp at Mount Arden, and now for the third time he made this spot his base for exploration work. He followed up the eastern shores of Lake Torrens, and rounded the northern end of the Flinders Ranges. He found his progress blocked by great stretches of saline mud on three sides, and gave up all hope of pursuing his way further in that direction. Mount Deception and Mount Hopeless were named by him, expressive of his disappointment and failure, and at the latter place he turned back. From this experience Eyre erroneously concluded that Lake Torrens was of horseshoe shape. Sturt made a similar mistake and the lake appeared of this shape in the early maps of Central Australia.

Foiled in his attempt in the north, Eyre determined to make another effort to find a way through along the south coast to King George Sound. He sent his party under the charge of Baxter by a direct route to Streaky Bay, while he went round by Port Lincoln to obtain additional supplies. Supplies were carried to Streaky Bay and Fowler Bay by ship, and thence the party started on their perilous way, following the coast line. Their journey affords the most thrilling story of dogged perseverance and extreme privation within the records of Australian explorations. Eyre started from Fowler Bay in November, 1840, but was twice driven back upon his base through want of water. Making a fresh start in February, 1841, and taking with him only one white man (Baxter) and three natives, he hoped to make a dash through the waterless desert in front of him. Five days passed and a distance of 135 miles was covered before water was found; and thence, seven days and 160 miles, before another water soakage was met with. On April 26th, in the absence of Eyre from camp, two of the natives of the party shot Baxter fatally, and deserted with some of the arms and all the stores they could carry away. Eyre and Wylie (the third native of the party, who belonged to King George Sound, and remained faithful to his leader), covered another 150 miles of waterless country under great privations. Both men became ill and with their stores entirely exhausted their case was desperate, when on going down to the sea shore on June 2nd, to their great joy they found a French whaling ship at anchor in a sheltered bay, which Eyre named Rossiter Bay in honour of the captain of the ship. After recruiting for twelve days on board the *Mississippi,* as this vessel was called, they resumed their journey and arrived at Albany on July 7th. This heroic effort of Eyre only demonstrated the impracticability of the southern coast as a travelling route to the West.

In 1844 an attempt to cross the centre of the continent and solve the question of its physical features was made by **Captain Charles Sturt,** who had already distinguished himself by explorations in New South Wales. Having obtained the sanction of the Home Government, Governor Grey supplied the outfit. The party consisted of Captain Sturt, Mr. Poole second in command, Dr. J. H. Browne, as surgeon, Mr. J. McDouall Stuart, and twelve others. An element of irony entered into the arrangements, as Sturt set out to explore the arid interior with a boat and boat-carriage as part of his stores. Warned by Eyre's experience on the mud flats of Lake Torrens, Sturt determined to make the River Darling his starting point, hoping that the Barrier and Grey Ranges would supply watercourses, running west, by which he might safely penetrate far into Central Australia. The party left the Darling at the end of September 1844, and crossed into South Australian territory a little to the south of Callabonna Creek. The size of the expedition with its number of live stock and impedimenta made its movements difficult and precarious. The failing of water compelled the party to camp for six months on the rock waterholes of Depot Glen, near Mount Poole, on the western side of the Grey Range. Scurvy attacked the party and Poole died. Rain fell about the middle of July, 1845, and the camp was moved on to Fort Grey depôt, on Frome Creek, at the north end of the Grey Range. Sturt, generally accompanied by Browne, made long excursions from the camp chiefly towards the north-west, and discovered Lake Blanche (which the explorers incorrectly assumed was the eastern bend of Lake Torrens); Strzelecki Creek, Cooper Creek, and Eyre Creek, the last named being near Sturt's furthest north, which was reached on the 138th meridian, and 24° 40′ south latitude. The drying up of creeks and waterholes compelled the whole camp to retreat to the Darling, after being in the field nearly two and a half years. Sturt's achievements take rank amongst the most notable of Australian explorations. The great privations suffered by the intrepid explorer permanently undermined his health, and he was granted a Government pension of £600 a year. Sturt's report on the illimitable sandhills and stony deserts over which he had passed, and which he believed extended to the Great Bight, was not of a kind to stimulate settlement in the interior.

During the next few years renewed attention was paid to the Lake Torrens country with a view to settlement. Two pastoralists, **Oakden** and **Hulkes,** travelled up the west side of the lake in 1851 and spoke well of the country, but they did not take it up for occupation, and the outline of the lake still remained a mystery. A government expedition, with **B. H. Babbage** as leader, in 1856, discovered permanent water near Lake Torrens, and in 1858, this explorer was again at the head of a strong Government party, surveying the country between Lake Torrens and Lake Gairdner. In the same expedition Babbage followed Stuart Creek down to Lake Eyre, which he recognised as distinct from Lake Torrens, giving it the name of Lake Gregory, after the second officer in command. Whether merited or not, the Adelaide authorities lost faith in Babbage, who was recalled, and his discoveries ignored, and from a popular suggestion made at the time, the Lake Gregory he had discovered and named was renamed Lake Eyre by official consent. Babbage believed that Sturt's so-called eastern limits of Lake Torrens consisted of a series of salt pans and lakes which had no connection with Lake Torrens, but he was prevented from testing this conclusion in consequence of his recall. This surmise, however, was subsequently proved true by the explorers Warburton, Parry, and A. C. Gregory.

A bonus of £4,000 offered by the South Australian Government in 1851, for opening up the River Murray for navigation, subject to certain conditions, stimulated enterprise in that direction. The first steamboat to ply on the waters of the Murray was built by

Captain W. R. Randell, at Mannum, and his trial trip reached as far as Echuca; but his vessel did not meet the Government conditions. The bonus was obtained by Captain F. Cadell, who having first tested the water-way in a canvas canoe, from the junction of the Darling southwards, formed a company in 1853, named the River Murray Navigation Company, and the steamboat, *Lady Augusta,* was built for trading purposes. The venture ended in a commercial failure; but the carrying trade on the Murray was revived at a later period with better success.

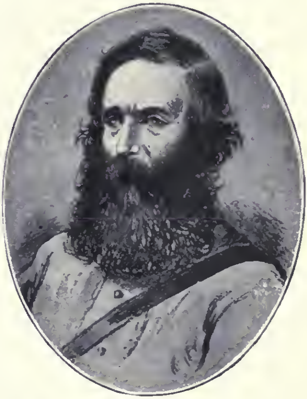


Fig. 49. John McDouall Stuart, the First Explorer to cross the Continent from South Australia to the Northern Coast.

In 1858 **John McDouall Stuart** (Fig. 49), who had been draughtsman in Sturt's expedition, began a series of explorations of great daring which culminated in his crossing the continent. In a three months' trip, with one white companion and a native, he passed up the east side of Lake Torrens and the south end of Lake Eyre, and penetrated the unknown country to the north-west, round Stuart Range. Then, taking a course south-east, he came to Lake Younghusband, and passing north and west of Lake Gairdner, struck the coast a little east of Fowler Bay, and returned to Adelaide by way of Mount Arden. During the latter part of this expedition the explorers had to live on what they could find, and would have starved but for the marsupial mice which for some time supplied them with food. In the following year Stuart was on the west side of Lake Eyre, when he discovered several important mound springs, which mark the south-western limits of the great artesian basin.

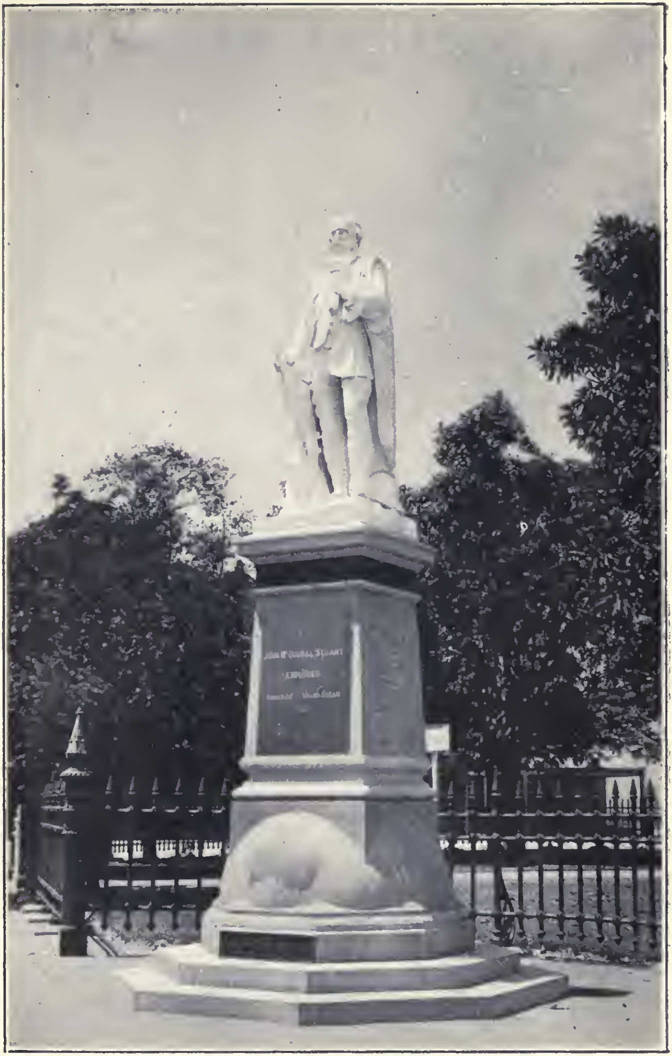
The Government having offered a bonus of £10,000 to any one who succeeded in crossing the Continent from south to north, at his own cost, Stuart made an attempt in 1860 to do this, with only two companions, Kekwick and Head. Travelling up the west side of Lake Eyre he made the Neales River his starting point on March 17th. Stuart discovered the Stevenson and the Finke Rivers, Chambers Pillar (a great butte of sandstone in the form of a pillar, 105 feet high, rising from the top of an isolated hill) ; the Hugh River, the MacDonnell Ranges, and the Reynolds Range. On April 22nd of the same year, Stuart found by observation that he had reached what he regarded as the centre of the continent, and to mark the event he raised the Union Jack on a hill which he named Central Mount Stuart. From this point the explorers attempted to make for the Victorian River, but when within 300 miles of the place Stuart had reluctantly to return. In a sore plight, weakened by scurvy, his horses knocked up, the natives hostile and troublesome, this brave leader was compelled to give in and reached settled country at the beginning of September.

Although this attempt to cross the continent was unsuccessful it demonstrated the possibility of the task, and on the following New Year's Day, 1861, Stuart, with Kekwick second in command, entered upon another attempt in charge of a larger and better equipped party, fitted out by the Government, and on April 24th of the same year reached the farthest point attained on his previous journey. Little progress could be made during the next month on account of the difficulty in finding water, and on several occasions the party had to fall back on known water holes. The discovery of Newcastle Waters, north of Powell Creek brought relief. But the worst had to come—impenetrable scrub, waterless wastes, boggy ground that was difficult to ride over yet yielding no drinking water, the natives attacking the party whenever opportunity occurred, reduced stores adding the miseries of semi-starvation to those of perpetual thirst. Attempts to penetrate that dreadful belt of country were made first in one direction and then in another, with the same fruitless results. Return was the only alternative, and after a nine months' struggle with adverse circumstances the party reached succour when reduced to the greatest destitution.

The two failures to cross the continent did not dishearten either the Government or Stuart; and early in 1862 the intrepid explorer once more left Adelaide with the object of forcing his way through to the northern shores of the continent. Reaching the district from which he had been compelled to retreat the previous year, better success attended the search for a practicable route. Purdies Ponds was reached on June 11. Subsequently the Strangways River was struck, and proved to be a tributary of the Roper, following which, the explorers passed Chambers Creek and entered a series of gorges cut by the streams in the Desert Sandstone. Amongst these was the Katherine, a tributary of the Daly River, and the country then assumed a markedly tropical aspect. On July 18th the Adelaide River was discovered, and on the 25th, after a journey of eight miles, F. W. Thring, who was in advance of the party, suddenly emerging from a thick scrub, shouted back to his companions "The sea!" The coast reached was in Van Diemen Gulf, near what is now known as Point Stuart; and was marked by Stuart carving his initials (J.M.D.S.) on a large tree in the vicinity. Stuart led his party safely back, but it almost cost him his life. He was awarded a public grant of £2,000, and in 1904 a life size statue of the great explorer was erected in Victoria Square, Adelaide. (Fig. 50.)

Many other explorers than those referred to did valuable work in making the mysterious wastes of the interior give up their secrets, such as **Warburton, Giles, Forrest, Tietkins,** and **Lindsay,** who in separate expeditions crossed the arid belt between the Overland Telegraph line and Western Australia, mainly through the Gibson Desert—named after a member of Giles' party who perished by thirst in its transit. Such hazardous and trying work, in the accomplishment of which many lost their lives, has demonstrated courage and resource of the highest type. These are the heroes of Australian history and the martyrs to her progress.

Stuart's great achievement was quickly followed by the occupation of the central parts of Australia for pastoral purposes; and also led to the construction of the Overland Telegraph, which brought Australia into telegraphic communication with the world beyond.



Govt. Photo.

Fig 50. Statue of John McDouall Stuart, Victoria Square, Adelaide.

In 1848 the receipts from sales of Government lands amounted to £32,935, but in 1854 it reached £383,470; and the revenue from all sources, in the same period, advanced from £82,911 to £595,356. The population at the end of 1854 was estimated at 92,545.

REFERENCES.

CAPTAIN C. STURT.—"Two Expeditions into the Interior of Southern Australia during the years 1828, 1829, 1830 and 1831." 2 vols. London. Also, "Narrative of an Expedition into Central Australia, during the years 1844, 1845, 1846." 2 vols. London.

E. J. EYRE.—"Journey Overland from Sydney to Adelaide in 1837-8.'' *S. Aus. Record* ''Excursion to the Northward of Spencer Gulf and Eastward to the Murray in 1839." *Govt. Gazette.* "Expedition to the North-west of Port Lincoln and from Streaky Bay to Lake Torrens in 1839." *Govt. Gazette.* "Journals of Expeditions of Discovery into Central Australia, and Overland from Adelaide to King George's Sound in the years 1840-41." 2 vols. London.

J. McDOUALL STUART.—"Exploration across the Continent of Australia, in 1861-2." Melbourne. "Exploration in Australia: Journals during the years 1858-1862." London. Also Parliamentary Papers in years 1858, 1860, 1861, 1862, and 1863.

COLONEL P. G. WARBURTON.—''Journey across the Western Interior of Australia." London, 1875. Also Parliamentary Papers in the years 1864, 1866-7, 1875.

ERNEST GILES.—"Geographic Travels in Central Australia from 1872 to 1874." Melbourne. Also Parliamentary Papers in the years 1874, 1875, and 1876.

JOHN FORREST.—"Explorations in Australia." London, 1875. Also Western Australian Parliamentary Paper in 1875.

ERNEST FAVENC.—''The History of Australian Exploration from 1788 to 1888.'' Sydney, 1888. ''The Explorers of Australia.'' Christchurch, 1908.

For further references see Gill's "Bibliography of South Australia."

CHAPTER III.—PRODUCTS OF THE SOIL.

In the settlement of a new country there must be a longer or shorter period in which cultivation is experimental. The suitability of soil and climate for particular crops can only be learnt from experience. New conditions demand new methods, and it may require the accumulated experience of several generations to exact from the soil its full capacity of productiveness. This is strikingly illustrated in the agricultural developments of South Australia.

A.—AGRICULTURE.

The early settlers of South Australia believed that the soil and climate of the country were unsuited for wheat growing, yet it has become one of the leading products of the State. The principal agricultural districts are: (1) The Adelaide and Coastal Plains, extending as far north as Quorn and Port Augusta. (2) Yorke Peninsula. (3) The southern portions of Eyre Peninsula. (4) The eastern slopes of the Mount Lofty Ranges. (5) The Murray Flats, including Pinnaroo and parts of the "Ninety-Mile Desert." (6) The South-East between Border Town and Port MacDonnell. (7) The north-east portions of Kangaroo Island.

The limitation of cereal growing in the State is mainly determined by the rainfall. Mr. Goyder (late Surveyor-General), drew a line on the map of South Australia which marked the limits of an average rainfall of about 14 inches, to the north of which wheat could not be profitably grown. (Fig. 51). Improved methods of

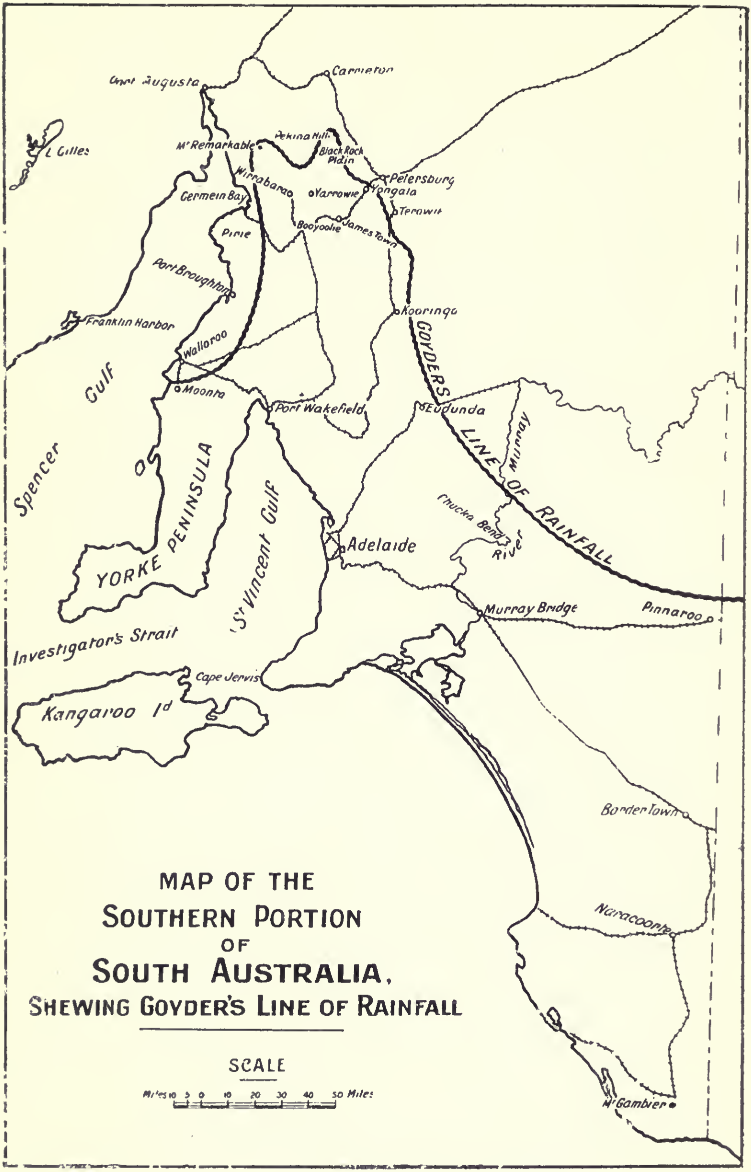


Fig. 51. Map showing Goyder's Line of Rainfall.

agriculture have extended this line in some directions, but it must be regarded as substantially correct. Within "Goyder's Line of Rainfall," the seasons are sufficiently regular to secure (where the land is properly farmed), a profitable yield. If the South Australian farmer suffers at times from dry seasons, he commands many advantages by which he can gather, at very low cost, crops of a quality scarcely to be exceeded in any other part of the world.

Wheat is the principal grain under cultivation. With the early autumn rains, in March and April, ploughing begins; sowing takes place in April, May, and June; the crop is in ear in November, and is reaped in December and January.

Two South Australian inventions have greatly facilitated agricultural operations whilst decreasing the cost: they are the "stump-jumping" plough* and the "stripper." Much of the virgin land of the State was densely covered with scrub and entailed great initial cost in clearing. An expeditious method of clearing the ground, known as "mullenizing" is effected by heavy rollers which crush down the scrub preparatory to burning. The cleared ground is then broken up by the stump-jumping plough, which is so constructed that on striking a root it lifts and slides over the obstruction, thus saving the heavy cost of "grubbing" the roots before cultivation. The "stripper" does the harvesting by beating off the ears of corn from the stalk, leaving the straw ungathered, and the latter is generally got rid of by burning. The wheat is winnowed on the field, bagged, and is at once ready for market. As the stripper can only act satisfactorily when the plant is dead ripe and brittle, hot, dry weather is essential for harvesting operations; moreover, the grain is apt to shell out, especially if strong winds occur. The grain that falls in this way is not lost as it helps to make a grazing pasture for the next season. What are known as "complete harvesters" are now much in use, and are gradually displacing the strippers. These machines strip, winnow, and bag the grain ready for market, all at the same time. (Fig. 52.)

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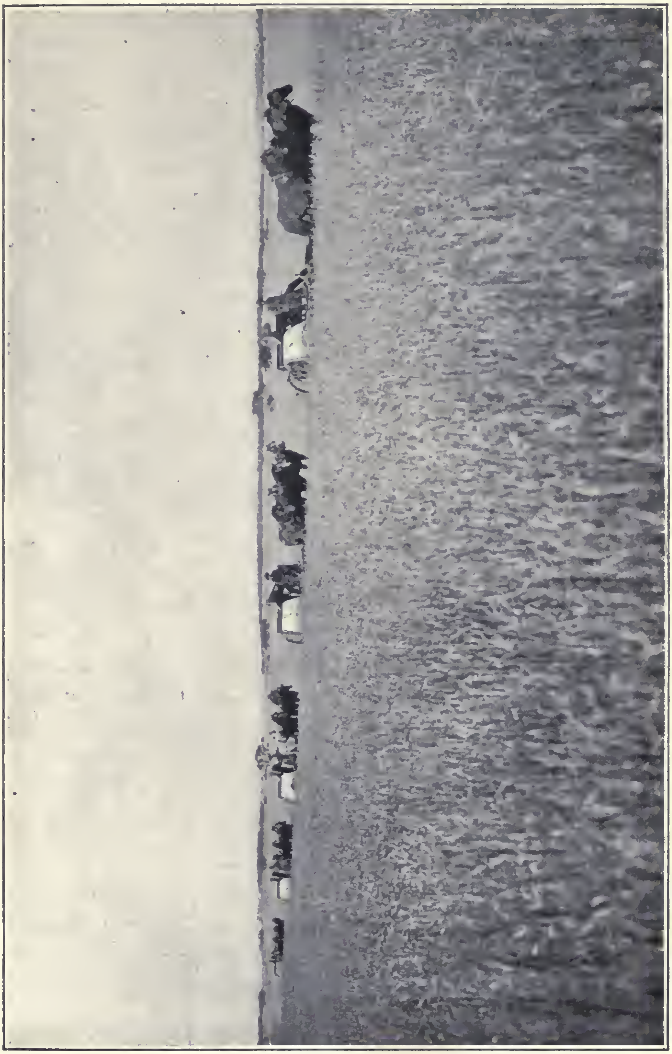
* It is uncertain who first introduced the stump-jumping plough. There are several claimants for the invention both in South Australia and Victoria. The idea probably occurred independently to several persons, at or about the same time.

The climatic conditions of the country are unsuited to the system of "rotation of crops" (usually adopted in European countries), and the South Australian farmer has found it expedient to follow a triennial system of cultivation. The land in wheat one year, is pastured with sheep or cattle the next, then fallowed the following year, and is sown with wheat again the third year. This system is adopted to prevent an exhaustion of the land for wheat growing.

The use of mineral manures, chiefly in the form of superphosphates, has during recent years greatly increased the productiveness of the land. The good effects are best seen on light soils where their use has augmented the yield of wheat, in many instances from 50 to 100 per cent., and even more. In 1897, 3,000 tons of commercial fertilizers were used, but in 1916 the amount had increased to 102,685 tons.

This improved condition of South Australian agriculture is no less due to a careful and scientific



Govt. Photo

Fig. 52. Five Complete Harvesters at Work in the Harvest Field. The Machine Strips, Threshes and Bags the Wheat all at the same time.

treatment of the soil which has become general in recent years. The system known as "dry farming" has been adopted for semi-arid districts. In this system the top soil for a depth of three or four inches is kept loose by frequent harrowing, especially after rain, to prevent the surface from caking. By this method, especially when done in conjunction with a "sub-packer," the water is conserved in the soil, evaporation is arrested, a free access of air is permitted, and the nitrification of the soil is promoted. It has been found possible by such means to secure good harvests where the rainfall has not exceeded ten inches, or even nine inches. Further advantages have been gained by the selection of varieties of grain which are best suited to the climatic conditions, by being either "drought-proof" or "rust-proof."

The average yield of wheat for the forty years (1861-1900), was 6.34 bushels per acre. In 1905-6, the average was 11¾ bushels; and in 1915-16, 12½ bushels. In the last named year, the total production of wheat was 34,134,504 bushels, and there was exported 175,247 tons, having a value of £1,440,682.*

The average is considerably affected by the returns from the Far North, where, in many places, agriculture has extended beyond the limits of adequate rainfall. In the opinion of Mr. Coghlan, the statistician, "owing to favourable conditions of culture, a yield of seven bushels an acre in South Australia, is financially as satisfactory as one of fifteen bushels in New South Wales or twenty bushels in New Zealand."

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*The exports would have greatly exceeded these figures had there been shipping facilities for getting the grain away.

Oats are grown chiefly in Yorke Peninsula, Kangaroo Island, and the south-eastern portion of the State. The Mount Gambier district is rapidly extending the cultivation of this cereal, and two factories for the manufacture of oatmeal have been established. The areas of cultivation for **Barley** are similar to those for Oats.

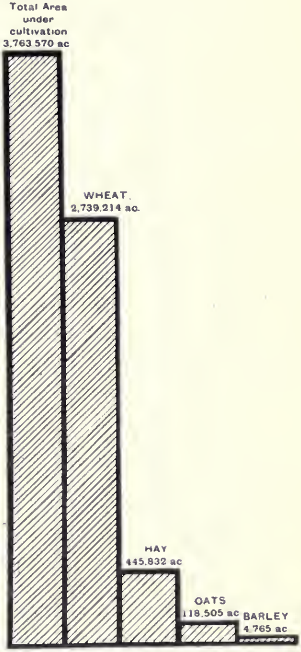

Fig. 53. Diagram showing areas under cultivation of cereal crops in South Australia, Season 1915-16 and proportion of each to total area cultivated.

Field Peas are mostly grown in the hills and the moister parts of the State where pig-raising and bacon-curing form an industry. The rich volcanic soil of the Mount Gambier district is utilised for the growth of **potatoes and onions.**

Hay—Next to wheat, hay-growing is the most important factor in South Australian agriculture. English grasses and clover are unsuited to the climate in the greater part of the State, and hay is made from wheat and oats which are cut for this purpose before the grain has completely matured. The haymaking as practised in Great Britain by drying in the sun, is unknown in Australia. The crop is cut by the reaper and binder, and then the sheaves are stacked for a short time in the field to dry before carting. Hay is an important article of export, chiefly to the other Australian States, in the form of compressed fodder, a mixture of chaff and bran. The average of the yield is over a ton per acre and represents a value of more than a million pounds sterling. (Fig. 53 shows in a diagrammatic form the areas under cultivation for cereal crops.)

B.—Fruit and Garden Produce.

South Australia, with its diversified climate, can grow a great variety of fruits. In a distance of twelve miles direct east from Adelaide the land rises from near sea-level to a height of 2,000 feet. In the South-East and in the elevated districts of Mount Lofty, Barossa, and the southern Flinders, every kind of European fruit grows to perfection; whilst on the lower slopes of the hills, the Adelaide Plains, and the irrigated flats of the River Murray, the fruits of the warmer temperate climates, such as those of the Mediterranean, are cultivated with great success.

Oranges and **Lemons** grow luxuriantly in and around Adelaide, especially on the light and deep soils beside the rivers and creeks. The irrigation settlements on the Murray are large producers of the citrous fruits. When properly cultivated the fruit is equal to the finest in the world. In 1916 there were 330,186 orange trees in South Australia grown for market purposes, producing about 73,455 bushels of fruit for sale. Lemons are astonishingly prolific, flowering and bearing fruit all the year round. The crop placed on the market amounted to over 17,000* bushels.

Apples, Pears, and **Quinces.**—All the leading varieties of apples and pears cultivated in the Northern Hemisphere, are grown, exhibiting their highest standards of quality. Of late years great care has been exercised in the selection of approved varieties for export, and very large areas are now devoted to the growing of special kinds for the European markets. The codlin moth, which in colder climates is kept in check by long and severe winters, becomes a much more prolific pest in the milder climate of Australia, but it has been demonstrated that this troublesome enemy can be rendered comparatively harmless by frequent spraying of the trees with certain chemical solutions during the growth of the fruit.

Stone Fruits, such as apricots, peaches, plums, prunes, cherries, etc., do equally well as those fruits already mentioned. The European berry fruits—gooseberry, raspberry, etc., do not grow well on the plains and are usually planted on moist flats, near the creeks in the hills. Wide areas of strawberries, which return a handsome profit to the cultivators, can be seen on the sheltered slopes of the ranges. Amongst other varieties of fruit trees which grow luxuriantly are the fig, loquat, mulberry, persimmon, almond, walnut, chestnut, and indeed, from the wide range of choice as to both latitude and altitude, might be added almost every kind of fruit cultivated within the temperate zone.

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*This was an exceptionally bad year for citrus fruits.

Most of the garden fruits, such as apricots, peaches, prunes, apples, pears, etc., are dried in considerable quantities, either by exposure to the sun or in drying frames subjected to the artificial application of heat. The cultivation of the Zante currant, as well as the varieties of grapes suitable for raisins, is rapidly extending—the annual production having increased tenfold from 1898 to 1908. The chief localities where raisins and currants are produced, are Angaston, Tanunda, Reynella, McLaren Vale, Clare, Auburn, and Renmark on the River Murray.

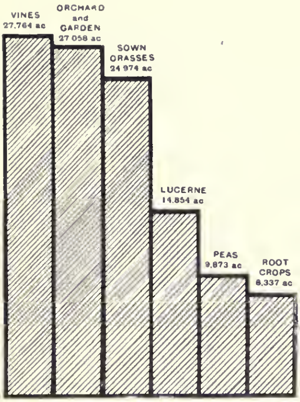

Fig. 54.
Diagram showing acreage of "general" crops (all other than cereals) in South Australia, Season 1915-16.

Garden Produce.—The rich soils of the gullies and valley bottoms are largely utilised for vegetable gardens. Most of these gardens are irrigated by water from a local creek; the growth in them is luxuriant, and vegetables of many kinds are raised almost the whole year round. The principal markets for fresh fruits and vegetables are found in Adelaide, Broken Hill (N.S.W.), the Northern Areas, and Western Australia. The export fruit trade will be dealt with below, (see page 262). (Fig. 54 represents diagrammatically the acreage of "general" crops).

Grand total of value of crops, season 1915-16, £12,833,147; value per head of population, £29 3s. 9d.

C.—DAIRYING AND OTHER INDUSTRIES.

In the early days of the Colony, the distances to markets and the difficulties of conveying butter during the summer months prevented any great development of the **dairy industry**. The introduction of the cream-separator, and the establishment (in 1885) of butter and cheese factories, placed the industry on an entirely new and more profitable basis. This came as a special benefit to the farmers in the drier regions, where dairying has proved a more certain source of income than wheat-growing. To assist the producer the railways carry cream and milk at a very small charge.

The butter industry received further stimulus when, in 1893, the Government, by Act of Parliament, offered a bonus on all butter of a given standard shipped to oversea markets from South Australia. The export of this commodity immediately jumped from 16 tons to several hundred tons per annum. Adverse seasons, followed by the war, limited the exports, and for the year 1915-16 only 57½ tons were exported, the whole of which was sent to the United Kingdom.

The dairy herds are chiefly shorthorns, Jerseys, and Ayrshires. A cross between shorthorns and Jerseys is much in favour. Most farmers find it expedient especially in the districts of uncertain rainfall, to widen their sources of income, by combining dairying with wheat-growing and sheep-farming. Where the rainfall is sufficient or irrigation can be applied, fodder plants, such as lucerne, peas, rape, kale, maize, sorghum, mangolds, etc., are grown for cattle. In times of plenty some dairymen conserve the coarse herbage in silo pits, which, as ensilage, makes useful fodder.

In 1916 there were reported to be 56 butter and cheese factories in operation in the State. These factories, together with farms, produced, for the year mentioned, 6,317,613lbs. of butter, 1,412,692lbs. of cheese, and cured 2,432,485lbs. of bacon and hams.

Pig rearing has not increased in South Australia proportionately to other agricultural interests. Over a hundred thousand pigs are reared annually, but the high price of pork and bacon indicates that this field of enterprise is not overdone.

Poultry supplies a means of income to the agriculturist which is becoming more and more appreciated. In the methods of South Australian farming much grain is shed and fowls are almost able to pick up their own living on the farms. They are chiefly valuable for the egg industry and with an expanding trade in the export of eggs to Europe this industry will become increasingly important to South Australia.

Another minor industry is **bee-keeping**, which requires only slight manual labour and involves little cost. The climate and flora of South Australia are eminently adapted for apiculture. Forests of flowering Eucalypts, rich in their honey bearing qualities, occur in abundance, as well as the rich undergrowth of flowering shrubs characteristic of the virgin forests. An average season produces a total of 500 tons of honey.

Government Assistance.—A Department of Agriculture is maintained by the South Australian Government in the interests of the cultivators of the land. Its object is to supply practical information on all subjects relating to agriculture, and adopt measures to prevent the introduction of pests and check the increase of those already prevalent. The Department is under the control of a Minister of Agriculture who is assisted by an Advisory Board. The executive officers comprise a Director, Secretary, Inspector of Fertilizers, Horticultural Instructor, Inspector of Fruit etc. There are at present (1916) 193 Agricultural Bureaus distributed throughout the country as local centres, in touch with the Department for the discussion of all subjects of agricultural interest, and for carrying out experimental work. The *Journal of Agriculture* is the official organ of the Department.

D.—Pastoral Occupations.

The pastoralist, or "squatter," has been the true pioneer in opening up the interior of the country. In the early days of settlement the open lands within easy reach of the capital were utilised mainly for sheep, but with the rapid growth of agriculture, the squatter (except where the freehold of the land was held), has been driven further and further into the interior. A few sheep were brought to the Colony by Governor Hindmarsh, but the first important shipment of stock to South Australia was made by J. B. Hack, who in 1837 introduced between 300 and 400 sheep, 6 heifers, and a bull. In the following year there were

28,000 sheep in the colony, and by the end of 1840 the number had increased to 200,160.

In these early times grazing rights were let by licenses on such terms that freeholders had the privilege of depasturing on Government lands to the extent of two square miles for each 80 acres of freehold land held by them. In 1851 a system of leasing Government land for pastoral purposes came into force at a fixed rental of £1 per square mile for first quality of land, 15s. for second quality, and 10s. for third quality. Such lands could be resumed by the Government on a six months' notice. A few years later more exacting terms were imposed on the pastoralists. In the case of outlying country, a fourteen years' lease was granted, on a rental of 2s. 6d. per square mile, per annum, with an assessment of one penny per head for sheep and one shilling per head for cattle. When the leases ran out they could be renewed for a like term, but the assessment was doubled, and at the end of this second term the improvements became the absolute property of the Government. On the expiration of the lease the pastoral run was relet by public auction and the improvements went to the incoming lessee. Great dissatisfaction was felt by the pastoralists on the three points—the insecurity of tenure, the highness of the rents, and the confiscation of the improvements. Instead of lowering the rents the Government, by an amended Pastoral Act, undertook to take over the improvements and compensate the outgoing tenant on a valuation. This proved an unfortunate expedient and led to the relinquishing of much pastoral country, which, from dry seasons and increase of wild dogs was making a poor return to the squatter. By a later Act (1893) it was provided that the incoming lessee should pay to the outgoing lessee the value of the improvements on the run, the valuation being approved by the Pastoral Board. The Acts relating to pastoral lands which came into force during the interval from 1893, were consolidated and amended by the Pastoral Acts of 1903-1904.

In these Amended Acts a Land Board was appointed to arrange the subdivision of Crown lands and fix the price. Land can be obtained from the Government either on perpetual lease, or on agreement to purchase. In the former case, the annual rental is from about ¼d to about 6d per acre. The rents of outlying pastoral estates in dry regions are regulated according to their stock-carrying capabilities. For the purposes of closer settlement, the Government (on the advice of the Land Board and the Surveyor-General), repurchases estates and divides them into suitable blocks for farms, etc. Homestead blocks, of a few acres, and up to £100 in value, may be obtained on perpetual lease or agreement to purchase, for the purpose of workmen's homes. Advances from the Government, as loans to "Blockers," can be obtained up to £50 on improvements. Any lessee, under the Government, who erects vermin-proof fences of barbed-wire and wire-netting, can, on the recommendation of the Land Board, draw on the Government for the amount spent, the same to be repaid, principal and interest, in twenty equal annual instalments.

Sheep.—Sheep require a certain amount of oversight. They cannot travel great distances to water, they succumb more readily under adverse conditions than cattle do, and it is necessary to fence in the runs where they are pastured; for these reasons a better class of country is required for sheep runs than is needed for either cattle or horses.

The pastoral districts of South Australia include much of the salt-bush and blue-bush plains of the North and North-East, the West Coast, the South-East, the hill country along the Mount Lofty and other ranges, and many fine runs in the agricultural areas. Generally speaking, the sheep country occupies an intermediate belt between the well-watered agricultural districts of the South, and the more arid regions utilized for cattle and horse breeding in the North. In 1907 there were nearly seven million sheep in South Australia, and over fifty million pounds of wool were exported. In 1914 (during the great drought) the sheep were reduced to a little over four millions. The flocks numbered 8,058, and there were 131 stations that carried over 5,000 sheep.

The Merino (Fig. 55) is the principal breed of sheep in the flocks of the State, and for many years it has been considered by sheep farmers that the Merino in South Australia has developed to a greater degree of general utility than is the case in any other part of the world.* The wool varies in type from fine to strong, according to the country in which the sheep depasture. The large flocks in the North and North-East are all Merinos, as are also those in the Middle

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*The average weight of wool per sheep in South Australia rose from 4.69 lbs. in 1861 to 6.41 lbs. in 1871; 6.98 lbs. in 1881; 6.85 lbs. in 1891; 7.49 lbs. in 1901; and 7.41 lbs. in 1907.

North, and grow to great advantage; indeed, the Australian conditions seem so eminently adapted to this breed of sheep that it produces a greater quantity and a more valuable class of Merino wool than can be obtained anywhere else.

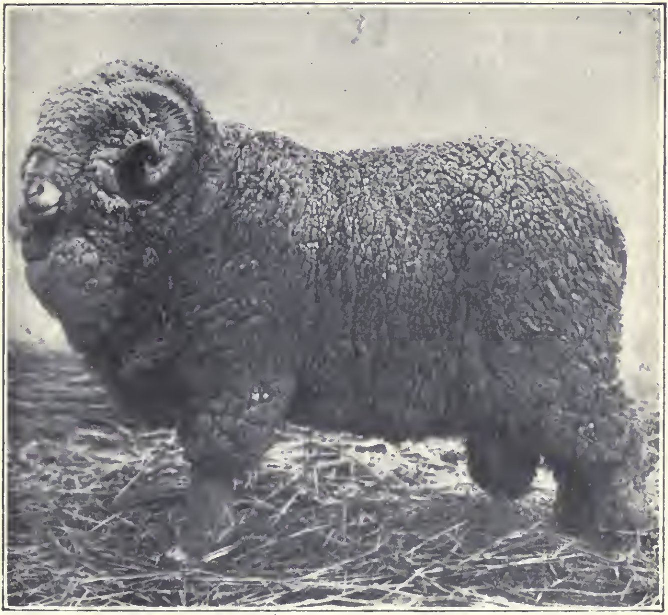


Photo. Scott.

Fig. 55. A prize Merino Ram, bred at the Hill River Station, South Australia.

Since lamb and mutton have been frozen and exported to Europe, the lamb breeders and small farmers in the closely settled districts have found it advantageous to cross the Merino with other breeds, such as the Lincoln, which carry long-woolled fleeces, are large sized, and mature early. These crossbreds are of general utility for wool, export, and local requirements. Lincoln sheep have been bred in South Australia for fifty years, but other varieties, such as the Black-faced Shropshire, the Dorset Horn, and the Southdown, only date back some twenty years, and have been introduced with the special object of producing the best returns in lamb and mutton. Since the use of mineral phosphates in South Australian agriculture, the stubbles have been much improved in nutritive qualities, and the system of resting the land from wheat-growing, which has become general of late, has led to sheep-farming being combined with wheat-growing to a much greater extent than formerly.

The climate of South Australia is highly adapted for the breeding of sheep, being warm, temperate and dry. No special herding or shelter is required for them in winter, and the flocks are practically free from the diseases which affect sheep in other parts of the world. Under favourable conditions the carcase of a four-months lamb may weigh up to forty, or even fifty pounds, and except in times of severe drought the percentage of increase ranges high, from 80 to 100 per cent. Great losses are incurred at times in the outlying country, but on the return of good seasons the recovery of the flocks to their normal strength is surprisingly rapid.

The great drawbacks to the pastoral interests in the Far North, North-East, and West, are (*a*) the recurring droughts, (*b*) the enormous increase of rabbits, when the seasons are good, and (*c*) the damage done to the flocks by the wild dogs (dingoes). The climatic difficulties are being met by artesian water and the reservation of strips of country as a stand-by in times of stress, while the rabbits and dingoes are combated by poisoning, trapping, and the erection of vermin-proof fences. Efforts to keep down the vermin are of little service without fencing, which consists of wire-netting and barbed wire, about four feet high, enclosing a run, so as to shut out both rabbits and wild dogs. In many places a Vermin District is declared, within which concerted action is taken, and a protecting fence is erected to enclose a district at the joint cost of all parties benefited thereby. The Government (as stated above), is prepared on certain conditions to advance the money for the erection of such fences. Foxes, which were introduced into Victoria a few years ago, have invaded and are increasing in South Australia to an alarming extent, but at present the injury they have done to the sheep is not great, and a redeeming feature of both dingoes and foxes is that they prey largely on rabbits, and thus help to keep their number down.

By careful selection heavier fleeces are being secured, and the wool exports of the State have reached a value of over two millions sterling. The chief countries to which South Australia sends its wool are the United Kingdom, Victoria, Belgium, France, and Germany.

Cattle and Horses.—The first herd of cattle and horses, introduced into South Australia, was brought overland from Sydney (numbering 335), by Joseph Hawdon, in 1838. (See p. 178). Two years later there were 15,000 cattle in the colony with a rapid annual increase (with the exception of one year), till 1893, when the number was estimated at

423,000. In the same year the horses were estimated at 186,726. During recent years the number of stock in the country has fluctuated greatly, chiefly by reason of the variable seasons. Horses can survive conditions of drought better than cattle. Following the great drought, the census of 1915-1916 showed the cattle to have decreased to 226,565, while the horses had increased to 253,333. The demands of settlement have driven the holders of cattle and horse stations further into the interior, where the rainfall is uncertain and occasional droughts decimate the herds. The artesian basin of Lake Eyre makes occupation for cattle-breeding possible over a wide extent of country that would otherwise be uninhabitable.

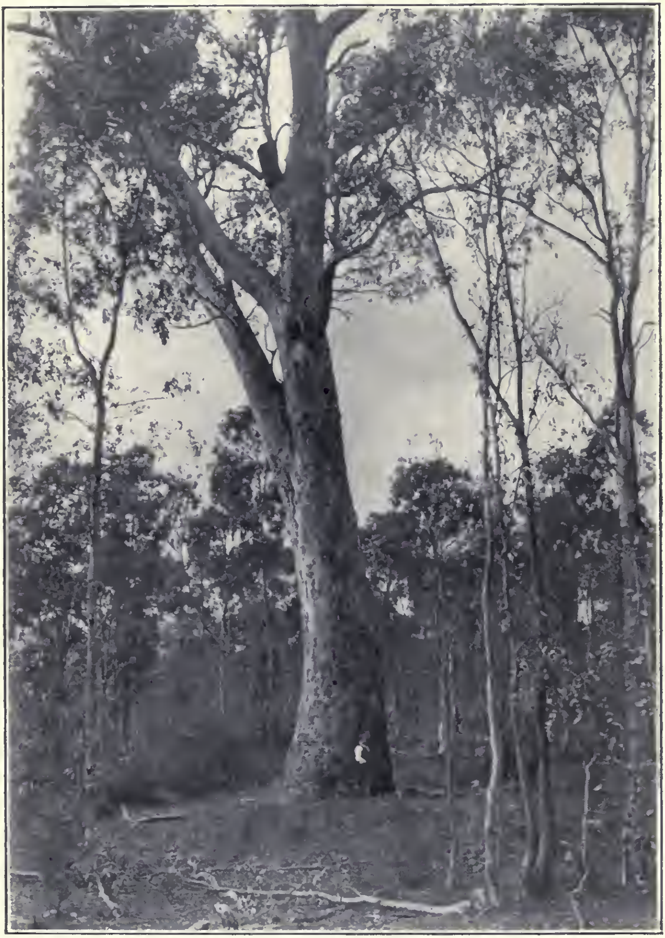
In these outlying districts the cattle-runs are sometimes as much as five thousand square miles in extent. No fencing can be erected to close in so great an extent of country and both the cattle and horses are in a semi-wild condition. Mustering for the markets is an exciting and arduous task, especially in the case of the horses, which run in 'mobs,'' and are difficult to bring in. The cattle are mostly shorthorns, occasionally Herefords, which with the other stock on the stations, have to find a living in subsisting on the perennial ''bush'' and a number of native grasses and other annuals which spring up with wonderful rapidity on the sand ridges after rain. The stock, when ready for the market, are driven to some railway station on the North line and trucked to Adelaide. The horses raised in this somewhat casual manner are not the highest bred, but they are particularly hardy, and possess great endurance, and are highly valued as military remounts. On the grass country further south, both cattle and horses, especially heavy draughts for farm work, are reared under more regulated conditions and from pedigree studs which have been imported at great cost.

E.—Forestry.

South Australia does not possess such extensive forests as occur in other States of Australia, and much of the tree-growing areas might be better described as "scrub" rather than forest, but a fair amount of heavy timber grows on the uplands of the southern portions of the State. Some kinds of indigenous timbers are excellently adapted for fencing, building and constructive purposes. (See under "Flora," Chapter IX., p. 151 *et seq.*). Taken as a whole, however, the wood of the native trees is not well suited for furniture-making and cabinet-work. The grain of the wood is often short and wavy and hard to work. On the other hand, these woods often display rich variations of colour with artistic grain and are well adapted for veneering and inlaid work. The "shea-oak" (*Casuarina quadrivalvis*), makes excellent spokes and pick-handles, and the "blackwood (*Acacia melanoxylon*), is a very valuable timber, works easily, and is extensively utilised for furniture, carriage-building and ornamental work.

In a relatively dry country, like South Australia, the conservation of the native forests and organised methods for the promotion of tree culture are of great importance. The attention of the Government was first directed to this subject in a practical way in 1873, and a Woods and Forests Department was established in 1875. The forest reserves and plantations under this Department total forty-one, scattered over the northern, central, western and southern districts, and comprise at the present time (1917) 148,529 acres. Twenty areas, aggregating 21,100 acres, are enclosed for planting. Some of the more important of these are Bundaleer (7,331 acres); Wirrabara (2,339 acres); Mount Brown (405 acres); Cave Range (312 acres); Wanilla, near Port Lincoln (487 acres); Ayers (559 acres); Red Hill (492 acres); Kuitpo (860 acres); Mount Burr (2,310 acres); Penola (827 acres); Caroline (393 acres), and Second Valley (235 acres). (Fig. 56).

The objects of the Department are to conserve the natural forests, to introduce exotic trees of economic value, and to encourage arboriculture by the gratuitous distribution of young trees. The chief varieties of trees cultivated in the planting areas are, the Sugar Gum (*Eucalyptus corynocalyx*); the Blue Gum (*E. leucoxylon*); the Victorian Ironbark (*E. sideroxylon*); the Narrow-leaved Ironbark (*E. crebra*); the Red Gum (*E. rostrata*); the Stringybark (*E. capitellata*); the Remarkable Pine (*Pinus insignis*); the Aleppo Pine (*P. halepensis*); the Maritime Pine (*P. maritima*); and the Canary Island Pine (*P. canariensis.* The introduced pines have done remarkably well and yield a good revenue. Steam saw-mills are in operation at Wirrabara, Bundaleer, and Mount Burr, for the purpose of manufacturing fruit cases and trays from the timber of these pines, which command a ready sale in the districts. During the last 14 years 596,529 cases have been cut.



W. Gill, Photo.

Fig. 56. A "Red-Gum" Tree (*Eucalyptus rostrata*), 120 feet high and 35 feet round the trunk, growing in the Wirrabara Forest, surrounded by saplings.

During the year 1915-16 the Department planted 436,652 trees, and distributed 302,491 young trees amongst 2,370 applicants. The total number of trees issued during the past 35 years amounts to 9,505,806. Although the income gathered from various sources, does not meet the expenditure, the Woods and Forests Department is doing valuable work in arresting the depletion of the native forests, and in supplying trees to beautify townships; it also gives the opportunity to farmers and others to grow useful timber on their lands whilst at the same time providing shade for their herds and flocks in the heat of summer.

At Lake Harry and at Hergott in the Far North, the Department made the experiment of planting over 2,000 date palms, about fifty of which were specially selected varieties imported from Algiers. The trees, although still young, and only in partial bearing, in 1906 yielded 1,213 lbs. of ripe fruit which found a ready market. After 23 years of experiment in palm growing in the far north, and from the experiences of the late severe drought, the Department decided, in 1915, to transfer the bulk of the palms from Lake Harry to the banks of the River Murray, which was successfully accomplished, and it is believed that the last-named locality will afford better conditions for their development than the arid climate of Central Australia.

F.—Viticulture.

No fruit is more characteristic of South Australian horticulture than the grape. The vine is in almost every garden of the lowlands, and the most luscious and tempting bunches can be bought in Adelaide at a trifling cost. The vine was introduced into South Australia from Sydney and the Cape of Good Hope within a few years of the founding of the Colony, and by its luxuriant growth demonstrated the suitability of the climatic conditions for its culture. The first attempt at wine making was undertaken by John Reynell, at Reynella, as early as 1846, since which time viticulture has become of great importance in South Australia and is capable of indefinite expansion.

The chief vineyards are situated in the following districts:—**Adelaide**: With the exception of Bankside, near Thebarton, the chief vineyards follow the lower slopes of the foot hills of the ranges, at Glen Osmond, Beaumont, Stonyfell, Magill, and Hope Valley.

Barossa: Greenock, Tanunda, Angaston, Pewsey Vale, etc.

Southern Districts: Happy Valley, Reynella, McLaren Vale, Clarendon, Kanmantoo, etc.

South-Eastern Districts: Penola.

Northern Districts: Clare, Watervale, Auburn, Riverton, etc.

Most of the large vineyard-holders possess wineries for the making and storing of wine. Seppeltsfield, near Greenock (which is said to be the largest winery in Australia), makes over 400,000 gallons of wine annually, and has a storage for a million gallons. There are many small proprietors of vineyards who do not make wine themselves, but sell their vintages to the wine makers. A well cultivated vineyard will yield from one to six tons of grapes to the acre.

according to the kind of vine grown, and may give an average net profit of about £4 per acre.

The wines of South Australia are treated so as to resemble the well-known varieties of European manufacture, and to secure more perfectly the flavour and bouquet of these wines some vignerons have imported the levures (*ferments*) of particular kinds, to be used in the process. It is thought, however, that the favourable conditions under which the vine is grown in South Australia may develop in the locally made wines individual characteristics that will commend them in the markets of the world.

G.--OTHER PRODUCTS.

Olives.—The olive, which is a native of Syria, finds the climate and calcareous soils of South Australia as congenial for its growth as its native haunts. The trees are hardy and require but little attention. The chief olive groves of the State are at Stonyfell and Beaumont (along the base of the hills adjacent to Adelaide), and there is a small plantation in connection with the Adelaide Gaol. Mr. G. F. Cleland has 900 trees growing on 14 acres, near Beaumont. Based on an eight-year's average, the trees yield 341 cwts. of berries per annum, from which is manufactured 682 gallons of **olive oil**, at a profit of £4 11s. per acre. The total yield for the State is about 12,000 gals., all of which is required for local consumption.

The **Wattle** is indigenous to South Australia and grows spontaneously throughout the Mount Lofty Ranges and elsewhere. It springs up after the land has been cleared, or after a bush fire, and is frequently sown for cultivation. Experts have said that the broad leaf, or "Golden Wattle" (*Acacia pycnantha*), of South Australia, is one of the richest tanning barks in the world. The annual yield of bark is about six or seven thousand tons, valued at £60,000. The wattle is also a gum-bearing tree, yielding a "gum arabic" of very adhesive quality, but rather dark in colour, which discounts its commercial value.

Eucalyptus Oil.—Many of the Eucalypts yield a characteristic oil in varying quantities, but the species most in favour for purposes of extraction is the *Eucalyptus cneorifolia*, or "Narrow leaf gum." This species is more of a scrub bush than a tree, and is restricted mainly to Kangaroo Island, where most of the oil is manufactured. The distilling is done by the farmers on the island who obtain the gum leaves and manufacture the oil at small cost, as an adjunct to their farming operations.

Xanthorrhoea Gum, variously called Botany Bay, Black Boy, Grass Tree, and Yacka Gum—is a resin, and not a gum. It exudes from the Australian Grass Tree, which has therefore received the scientific name, Xanthorrhoea—exuding yellow. The so-called "gum" is a light yellow, or red, resinous substance, which forms at the base of the long and narrow leaves, in lumps or layers. To obtain it the outer part of the stem is shaved off. It is used for making varnishes, but its chief commercial value arises from its containing picric acid, used in the manufacture of explosives. The industry of collecting the "gum" belongs exclusively to Kangaroo Island (where large areas are covered by the Grass Tree), and forms another source of income to the farmers on the island. It is all exported to Europe, and before the war, chiefly to Germany.

CHAPTER IV.—IRRIGATION AND WATERWORKS.

The great artesian basin of **Lake Eyre**, though of inestimable value for stock purposes, has proved, so far, of limited utility for irrigation. The water, though ample, is regarded as carrying too much mineral matter in solution for garden use. At Lake Harry and at Hergott, the water from the bores has been utilised for growing palms. Mr. Campbell, the Director of Agriculture in New South Wales, has however been very successful in growing orange trees by irrigation from artesian bores in the western parts of that State, and he thinks that by proper cultivation of the ground and judicious application of the water, the artesian supplies can be widely used for fruit growing. This is an application which has not, up to the present, been tried in the South Australian portions of the central artesian basin.

The artesian and sub-artesian supplies of the **Adelaide** and **Gawler Plains**, are being increasingly applied to intense culture, and throughout the extensive areas of the South-East, subterranean water can be tapped at shallow depths, giving the promise of great possibilities for this district in the near future.

The great water system of the **River Murray** and its tributaries is eminently adapted for irrigation on a very large scale. The low gradients of the river channels, the number of back-waters and alluvial flats bordering the river, and the purity of the water, all conduce to this end. The Murray (proper) pursues a very tortuous course, thereby greatly increasing its length, which extends to about 1,300 miles, of which the lower 400 miles is contained in South Australian territory.

In 1887, the Chaffey Brothers (of Californian experience), received concessions of land and water rights from both the Victorian and South Australian Governments for the concurrent establishment of irrigation colonies at Mildura (Victoria) and Renmark (S. Australia), with a maximum appropriation of 250,000 acres in each case. Renmark is situated on a wide alluvial plain, slightly above flood level, and 30,000 acres were to be offered to cultivators in the first instance. The contractors (Chaffey Brothers) engaged to spend during the first twenty years in progressive sums up to £300,000 in plant and irrigation works in each of the settlements named. The development of the irrigation colony at Renmark has not exactly equalled the original plans. The contractors have been relieved of their responsibility and the management placed in the hands of "The Irrigation Trusts" under Government control. At the present time the population of Renmark numbers a little more than a thousand people, and the annual crop produced is worth about £50,000. About 4,000 acres are under cultivation, nearly half of which is devoted to vines; then follow, in relative acreage, apricots, lucerne, cereals, citrus, peaches, and olives. The raisin grape, sultana grape, and the Zante currant are the varieties of the vine chiefly grown; these as well as peaches and apricots, are sun-dried. They attain a high quality, and find a ready sale in Australian markets, which buy the whole crop. (Fig. 57.)

Many of the swamps beside the River Murray have been reclaimed and are productive. More important enterprises of this nature have been proposed or are in course of construction. One of these is the utilisation of the water in Lake Bonney on the east side of Overland Corner, for irrigation purposes; and another is that of Lake Albert, near the mouth of the River Murray, an extensive shallow easily capable of being drained and brought under cultivation.

A system of **village settlements** on the banks of the Murray was inaugurated in 1893 under Government subsidy. With the exception of Lyrup, all of these have been abandoned as unsuccessful, and at considerable loss to the Government. The failure of the experiment was not due to the unfitness of the land for cultivation, but must be referred, primarily, to the communal basis on which the settlements were worked as well as to the inexperience of most of the settlers.

As far back as 1853 the South Australian Government sought the co-operation of the New South Wales and Victorian Governments for the purpose of making the River Murray of greater utility as an inter-state river. After prolonged negotiations and the work of several Royal Commissions, a mutual agreement between the States was arrived at and confirmed by the respective parliaments in 1915. The proposed scheme, which is estimated to cost £5,000,000, includes vast storage areas at Cumberoona and Lake Victoria, in New South Wales, to secure a sufficient supply of water in the channel to maintain navigation and irrigation, on a large

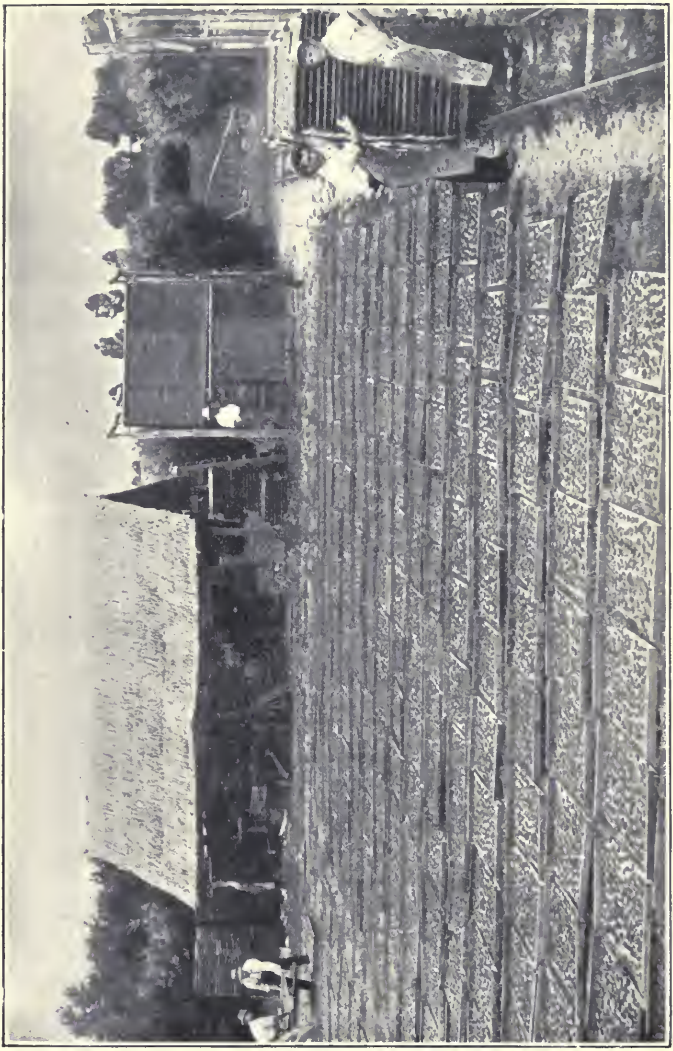


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Fig. 57. Drying Fruit by the Sun, Renmark, River Murray.

scale, throughout the year; together with 35 locks and weirs. Of these six will be built within the boundary of South Australia, beginning at Blanchtown, 170 miles from the mouth of the Murray. The foundation stone of the latter was laid on June 5th, 1915, by His Excellency, Sir Henry Galway, the Governor of South Australia, and is called the William R. Randell Lock, named after one of the pioneer navigators of the Murray. The cost of the entire scheme will be borne jointly, £1,000,000 by the Commonwealth, and the remainder, in equal shares by the States of New South Wales, Victoria, and South Australia.

Waterworks.—In a country that is subjected to periods of severe drought, as is the case in South Australia, it becomes a primary necessity that an ample storage of water should be provided, not only for normal times but for exceptional seasons. The Government has shown a wise providence in this respect in not only securing ample storage for the chief centres of population, but also for much of the agricultural areas as well.

Metropolitan Area.—In the early days Adelaide obtained its supplies from the water holes of the River Torrens, and the water, not always in the purest condition, was hawked through the city in water carts. Later, the reservoirs of **Hope Valley** and **Thornton Park** were constructed to store water conveyed from the River Torrens, which was tapped for this purpose at the weir, in the gorge of the river. With the rapid expansion of the metropolitan area, these reservoirs became inadequate to the growing demand, and the **Happy Valley** reservoir, with a capacity of 3,194 million gallons was constructed to supplement the supply. This fine sheet of water is fed from the Onkaparinga River by a tunnel having its inlet at Clarendon, four miles distant from the reservoir, and fourteen miles from Adelaide. Latterly the mains have been extended to the southward of the reservoir, nearly to Sellick's Hill, a distance of 20 miles, supplying the intermediate townships and farms. The increasing demands of the metropolitan area has led to the construction of the Millbrook reservoir, now nearing completion, which is built on the Chain of Ponds Creek, but receives the most of its supplies from the head waters of the River Torrens. The reservoir when full will have a storage capacity of 3,650 million gallons, and is the largest work of its kind in the State.

The **Beetaloo** reservoir is situated on the watershed of the Crystal Brook, in the southern Flinders Ranges, and supplies the almost waterless districts of Port Pirie, Moonta, Wallaroo, Kadina, and most of the country in northern Yorke Peninsula, as far south as Ardrossan, through a reticulation of 639 miles of cast-iron mains.

The Beetaloo waterworks proved inadequate to supply the needs of this wide district and led to the construction of a still larger reservoir at **Bundaleer**, with a capacity of 1,319 million gallons, which was connected with the Beetalo reticulation to augment its supplies.

The **Barossa** reservoir has been formed by constructing a weir, 95 feet in height, across the South Para River, making a storing capacity of 1,000 million gallons, and supplies 22 country towns, including Gawler, Lyndoch, Freeling, and the adjacent plains.

The town of Mount Gambier possesses a magnificent natural reservoir of purest water in the **Blue Lake** (Fig. 58), which occupies a depression, 250 feet deep, in the flanks of the extinct volcano from which the town takes its name. The water is pumped from the lake into service reservoirs and by reticulation is conveyed to the town and district.

The **Warren** reservoir, which was completed in 1916, is situated on the South Para River, Hundred of Barossa, and has a maximum capacity of 1,050 million gallons, and covers 230 acres. It supplies an area of 480 square miles, including the townships of Tanunda, Nuriootpa, and Kapunda.

The **Encounter Bay** reservoir is situated in the Hindmarsh Valley, and the chief supply is gathered from the Hindmarsh River. It has a holding capacity of 81 million gallons. The works were completed in 1917, and the reticulations extend over 21 square miles, including the towns of Victor Harbour, Port Elliot, Middleton, and Goolwa.

The **Baroota** reservoir is in course of construction on the Baroota Creek, in the southern Flinders Ranges. It will join on to the Port Augusta water service, 20 miles to the north, and augment the supply of the Beetaloo water district, as well as that of Port Pirie, 21½ miles to the south. It will hold 1,450 million gallons.

The **Pekina Creek** reservoir, near Orroroo, has a capacity of 338 million gallons, the water being used for irrigation on the adjacent plains.

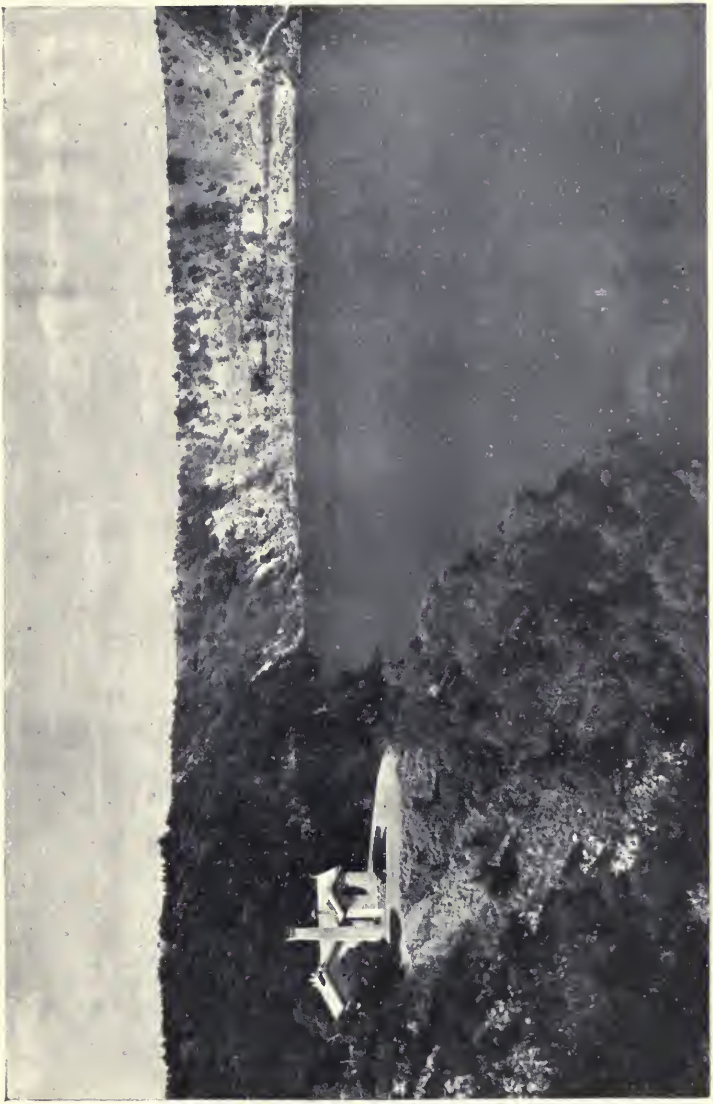

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Fig. 58. The Blue Lake and Pumping Station for the Town of Mount Gambier.

The occupation of **Eyre Peninsula**, of late years, for farming purposes, has made the water supply of that vast region one of great importance. Three reservoirs, up to the present, have been constructed, namely, Yeldulknie, Ullabidinie, and Ulbana. The catchment area covers 23½ square miles, and 115 miles of reticulation mains have been laid.

Many pumping plants with overhead tanks have been installed on the banks of the **River Murray,** which supply not only the towns on the river, but outside farms and irrigation plots.

Many smaller reservoirs and storage tanks have been constructed by the Government for local needs. The proclaimed water districts for reticulation comprise 6,685 square miles, and the construction costs have amounted to over £6,000,000. Were it not for the assured supply of water thus provided great hardships would be suffered by the community, and the profitable occupation of much of the land would be impossible.

CHAPTER V.—MINING.

Although mining does not occupy so important a place in the industries of South Australia as in the other States, a few mines of exceptional richness have been worked within its boundaries. It once produced more copper than any other State in Australia, but in 1906 its output was less than that of Tasmania, Queensland, or New South Wales.

COPPER.

The **Burra Burra** Mine, situated about 100 miles north of Adelaide, was discovered in 1845, and contributed largely towards the successful colonisation of the country at a critical period in its history. The ore, which consisted chiefly of red oxide and the blue and green carbonates of copper, formed a great basin-like deposit in limestone and kaolinized rock. The mine was worked as an open cut and produced ore to the value of nearly five millions of pounds sterling. In consequence of the depletion of the ore body the Company ceased operations in 1877, but a few tributers have continued to work the ground. Recently exploratory work has been carried on and good ore bodies have been proved where previously unknown.

Northern Yorke Peninsula is the most important copper producing district in South Australia. The principal mines are those of **Wallaroo** and **Moonta**, which with the extensive smelting works at the former, have, since 1889, been amalgamated into one company. The ore is chiefly in the form of sulphides of copper occurring in true lode deposits in igneous and highly metamorphic country. The Wallaroo Mine was discovered in 1860, and the Moonta Mine (situated ten miles south of the former), a year later. These mines have unitedly produced up to the end of 1916 copper amounting in value to £17,652,411, and paid £2,434,254 in dividends. The **Parramatta**, the **Yelta**, and the **Hamley** are smaller mines in the same district.

The **Kapunda** Mine, situated 50 miles north of Adelaide, was discovered by Messrs. Dutton and

Bagot in 1842, and is the oldest copper mine in South Australia. It was worked by the discoverers until 1878, when it was abandoned through an influx of water, since which time some tributing has been done in the upper levels. In the nine years, 1870-1878, the mine produced copper to the value of £156,883.

Copper is very widely distributed through the Flinders Ranges. Scores of mines have been more or less worked in these rugged highlands, but most of them have had only an ephemeral existence. Distance from the railway, absence or scarcity of water, and conditions which until recently made it impossible to treat low-grade ores profitably, led to their discontinuance. The **Blinman** mine, 20 miles east of Parachilna, has had an intermittent development since its discovery in 1862. In the hands of the Tasmanian Copper Company, Limited, it was for several years not only vigorously worked, but the erection of smelters at the mine stimulated the copper industry throughout the north. As the Company bought up low-grade ores in any quantity, a large number of small ventures came into operation in the district, which could not otherwise have found a market for their outputs. In consequence of the great fall in the price of copper that ensued the mine was closed down.

Gold.

The highlands of South Australia are composed of very old rocks, which have been greatly folded and crushed, and in them have been formed quartz veins that sometimes carry gold; but while gold can be got in small quantities in many parts of the hill country, no important goldfields have been established. The chief localities for reef gold are **Woodside, Echunga, Mount Pleasant, Blumberg, Barossa, Waukaringa, Mannahill, Wadnaminga**; and in the far north, **Tarcoola,** 250 miles north-west of Port Augusta, and **Arltunga** in the MacDonnell Ranges.

Some rich spots of alluvial gold have been discovered in a few places. The most important of these was the **Teetulpa** diggings which made a small rush in 1886, and produced over £300,000 of gold, but was soon exhausted. The **Barossa** and **Para Wirra** gold diggings, situated south-east of Gawler; and those of **Echunga** and the **Onkaparinga,** were worked in the alluvial of older lines of drainage which existed in Kainozoic times. A few "fossickers" can still be found on the Torrens and other streams in the hills at spots where a return may be anticipated sufficient to repay their labours.

To facilitate the treatment of gold ores the Government has established **crushing** and **cyaniding plants** at Mount Torrens, Petersburg, Tarcoola, and at Glenloth, near Lake Harris.

IRON.

In 1873 an attempt was made to produce pig iron from hæmatite obtained at the **Mount Jagged Iron Mine,** 13 miles north of Victor Harbour. The smelting works, which were on a small scale, were erected a few miles distant from the mine, on the Hindmarsh Tiers Road, in a situation where water, fuel (wood), and limestone flux were abundant, but the operations proved little more than an experiment.

The large demand for good quality iron-oxide ores by the Broken Hill, and other smelting companies, led to the opening out of numerous ironstone-flux quarries. Most of these are now no longer worked in consequence of the Broken Hill Proprietary Company having acquired the **Iron Knob** and **Iron Monarch** deposits, situated on the western side of Spencer Gulf, nearly opposite **Port Pirie**, at which latter place the Company's extensive smelting works have been established. The ore is of high quality and practically inexhaustible.

OTHER METALLIC ORES.

No **silver-lead** mines of importance are at present in operation in South Australia, although numerous ventures giving fair prospects of satisfactory returns have been tried at various times. Amongst these were the **Aclare Mine**, near Callington; the **Ediacara**, near Beltana; the **Taliska**, three miles north of Cape Jervis; **Avondale**, near Farina; and the **Wheal Ellen**, near Strathalbyn. The **Wheal Gawler Mine** (1841), and the **Wheal Watkins** (1842) both of Glen Osmond, were the first mining ventures in the colony. Some of the above mines carried a very high proportion of silver, but have been unproductive mainly through the high costs of working.

Bismuth.—The **Balhannah Mine**, although principally worked for copper, produced considerable quantities of bismuth associated with gold. Bismuth ores were obtained in the alluvial washings of Forest Range, and in the Daly, the Stanley, and Mount McDonnell mines of the Northern Flinders Ranges. **Cobalt** and **Nickel** occur near Mount Lyndhurst, Mount Ogilvie, Blinman, and other places in the North, but no permanent mines have been worked. **Manganese** deposits of considerable extent occur in many parts of the State and the mineral has been sent to Europe, when opportunity offered, as ballast in ships carrying wool. **Rutile** (an oxide of titanium) has been mined in small quantities at a mine between Mount Pleasant and Blumberg, at **Talunga, Para Wirra** (Mount Crawford), and a few other localities. A tungsten mineral, allied to **Wolframite,** has been mined at Callawonga Creek, south of Adelaide.

NON-METALLIC COMMERCIAL MINERALS.

Brown Coal.—At **Leigh's Creek,** 373 miles north of Adelaide, a basin in the older rocks (sixteen miles long and six miles wide), has been filled to a depth of 2,000 feet with a series of carbonaceous shales, brown coal, sandstone, and thin limestones. These beds are of Jurassic age, and belong to the upper coal measures of Australia that are worked in Victoria, Queensland, and Tasmania. The main coal at Leigh's Creek occurs at a depth of 1,500 feet and is about 48 feet in thickness. A colliery was established on the spot, but the inferior quality of the coal coupled with its distance from a market, made the venture unremunerative.

Poor carbonaceous deposits of Kainozoic age are found in many places in South Australia, and have repeatedly led to the expenditure of capital in exploratory work, but the deposits are little better than carbonaceous muds penetrated by thin strings of lignite and have no commercial value.

Salt and Gypsum.—The so-called salt "lagoons" of Yorke Peninsula are saucer-shaped depressions varying in size up to ten miles in circumference. (See page 105). The drainage of the country instead of finding its way to the sea sinks down to a clay stratum and accumulates within these sunken areas. During the summer months the water evaporates and the soluble salts contained in it are left behind. This process has gone on for a very long time, and as these "lagoons" are natural evaporating pans they have become the receptacles of large quantities of salt and gypsum, which form a white crystalline crust over the beds of the lakes in the dry parts of the year. The salt season lasts from November to March when the floors of the lakes are scraped, the salt is piled up into heaps and carted to the refining works. (Fig. 59.) About 400 persons are employed in this industry on **Yorke Peninsula,** and the annual output of salt amounts to about 60,000 tons. Salt deposits, found under similar conditions are worked on **Kangaroo Island,** and near **Snowtown** on the eastern side of the Hummocks. In the latter case, the **Bumbunga Lake,** six miles long, is the chief source of supply, and the salt is utilised for the mining operations at Broken Hill. The construction of the railway from Port Augusta to Western Australia will make available very large deposits of salt in the country through which the line passes. Arrangements are being made to begin this industry in scraping the very large floor of Lake Hart. **Gypsum** occurs in the saline muds of the "lagoons," and in some cases forms deposits around the banks, as in the case of **Lake**

Fowler (Y.P.) where hills of almost pure gypsum, fifty feet in height, surround the southern end of the lake. It is used for mineral manures and the manufacture of plaster of Paris.

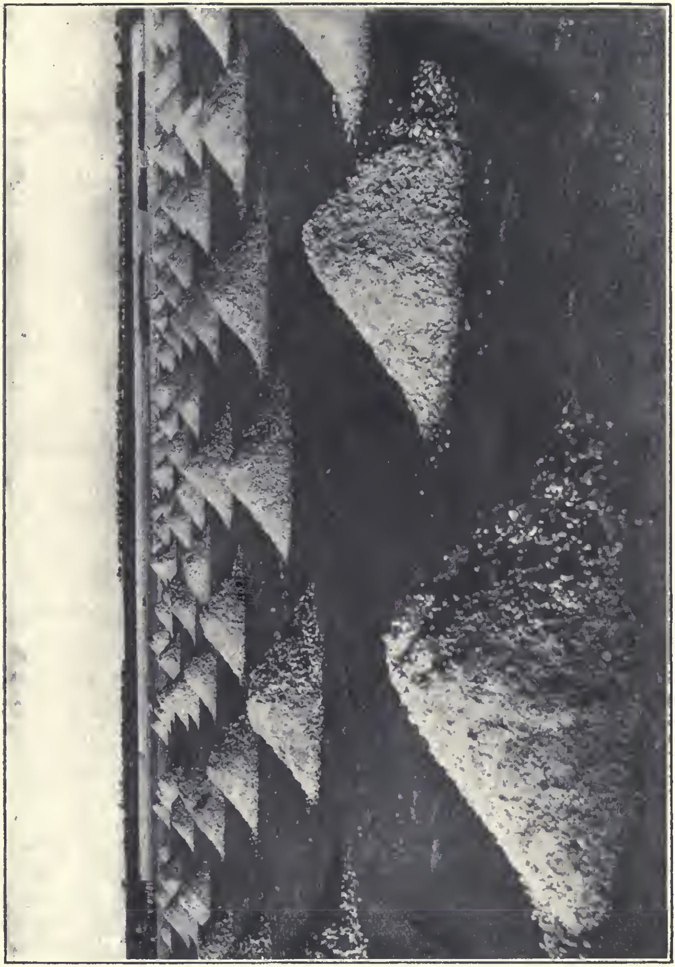
Mineral Phosphates.—A bonus of £500 offered by the South Australian Government for the discovery of mineral phosphates of marketable value, stimulated enterprise, and the discovery of phosphate rocks, near **Clinton,** Yorke Peninsula, was made in 1901. Subsequently important deposits of this class have been worked at **Fairview** east of the Burra, **Kapunda, Angaston, Noarlunga, Hackham**, and other places. The phosphate rocks of South Australia are usually found associated with limestones of Cambrian age, and result from a change in their composition from calcium carbonate to calcium phosphate. The stone quarried and sent to the manufacturers of superphosphate manures, ranges from 60 per cent. to 75 per cent. of tricalcic-phosphate. In the year ended December 31, 1908, 11,000 tons of rock phosphate were marketed, valued at £1 per ton. Of late years the importation of cheap and high-grade phosphates from Christmas Island and Ocean Island has militated against the development of this industry in South Australia.

A great variety of **clays** suited for the manufacture of bricks, pipes, earthenware, and kaolin suitable for porcelain, are widely distributed throughout the State. **Soapstone** and **french chalk** (forms of talc), used for furnaces, lubrication, and other purposes occur in large quantities in some parts of the Mount Lofty and Barossa Ranges and on Eyre Peninsula. **Mica** and **asbestos** have been placed on the market in small quantities, but no permanent industries in these minerals have been established. The recent discoveries of valuable deposits of **Alunite**, or **Alum Stone**, at Carrickalinga, and also in the Hundred of Napperby, render it possible that in the near future these raw products may be utilized for the manufacture of potash or aluminium.

Gems.—A diamondiferous drift occurs in the Echunga Goldfield from which it is reported that over fifty saleable diamonds have been obtained, ranging up to 9¼ carats, but the ground has not been systematically worked. Kangaroo Island has produced a variety of gems, including small rubies and precious tourmalines. The last named, in green, blue, and pink varieties, were found in considerable quantity as a pocket in decomposed graphic granite. Some of the crystals were particularly fine, being of large size and excellent colour. A company worked the ground till the deposit became exhausted. Small Oriental rubies and rough sapphires have been discovered near Williamstown.

DECENNIAL RETURN SHOWING QUANTITY AND VALUE OF SOUTH AUSTRALIAN METALS, ORES, ETC., 1906-1915.

	Quantity		Value £
Gold ...	58,507	oz.	241,257
Silver ...	26,784	,,	3,033
Copper ...	1,330,996	cwts.	4,649,033
Gypsum ...	82,980	tons	60,477
Lead Ore ...	2,275	,,	22,928
Salt ...	633,707	,,	413,381
Limestone ...	373,682	,,	92,830
Ironstone ...	735,301	,,	534,268
Phosphate Rock	62,369	,,	64,419
Radium ...	——		8,835
Wolfram ...	——		243
			£6,212,402



Govt. Photo.

Fig. 59. Salt Gathering from the Bed of Lake Fowler, Yorke Peninsula.

REFERENCES.

DUTTON, F.—South Australia and its Mines. London 1846

AUSTIN, J. B.—The Mines of South Australia. Adelaide, 1863. Ditto: Mines and Minerals of South Australia in Harcus' South Australia. Adelaide 1876

CLOUD, T. C.—A Catalogue of South Australian Minerals. Trans. Royal Society South Australia, Vol. VI. (1883), pp. 72-93.

BROWN, H. Y. L.—Numerous Records and Reports on the Mines of South Australia, published by the Mines Department, (S.A.) or as Parliamentary Papers.

JACK, R. L.—Geology of the Moonta and Wallaroo Mining District—Geolog. Sur. S. Aust. Bull. No. 6 1917

CHAPTER VI.—MANUFACTURES.

South Australia is more a producing country than a manufacturing centre. The absence of true coal from its mineral resources places a heavy charge on such industries as require driven machinery. There are also the further limitations of a relatively small population and the high price of labour, which make it difficult to compete with other countries. Among the more important manufacturing industries are the following:—

Agricultural.—Milling, wine-making, spirits, dried fruits, preserved fruits, jams, olive oil, honey (numerous centres).

Minerals.—Ore-smelting (Port Pirie and Wallaroo), salt-refineries (Yorke Peninsula and Kangaroo Island), hydraulic cements (Brighton and Stansbury).

Chemicals.—Acids, superphosphates (Adelaide, Port Adelaide, Wallaroo Mines).

Mechanical.—Agricultural and mining machinery, locomotives, rolling stock, castings, water pipes, tinware, etc. (Adelaide, Gawler, Ardrossan and Mannum.

Fictile.—Bricks, tiles, earthenware pipes, pottery, etc. (Suburban to Adelaide).

Textile.—Tweeds, blankets, rugs, and other **woollens**, (Lobethal and Thebarton).

Tanning.—Manufacture of leather and leather goods. (Hindmarsh and Adelaide).

Clothing.—Boots and shoes, ready-made clothing. (Adelaide and suburbs).

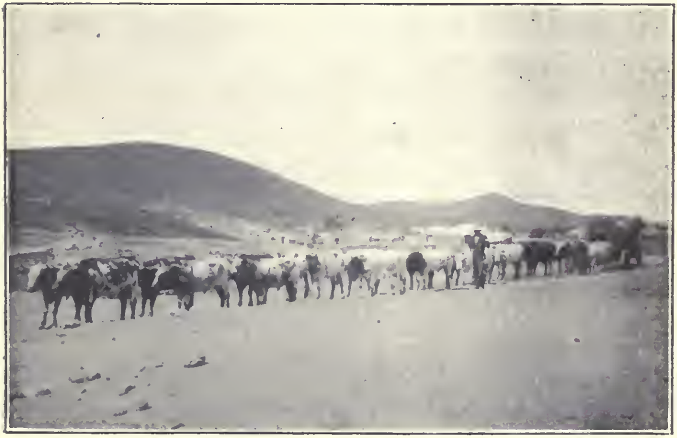
General.—Soap, candles, furniture, glass bottles, confectionery, stationery, etc. (Adelaide and suburbs).

CHAPTER VII.—MEANS OF COMMUNICATION AND TRANSPORT.

The advantages of waterways in promoting settlement and trade in a new country are self evident. South Australia is singularly destitute of rivers. It has but one navigable river (the Murray), and this is so situated that it cannot be a main artery of communication in the State. The early settlers were thus compelled, from the very beginning, to make their own highways of transport.

One of the first duties undertaken by the Government was to lay out and make **main roads.** Abundant road metal of excellent quality (quartzite), is widely distributed, and the main roads of the State, which are under Government control, have long been noted for their excellence. Outside the main roads, the District Councils have charge of the roads within the limits of their respective districts, and these are maintained by district rates.

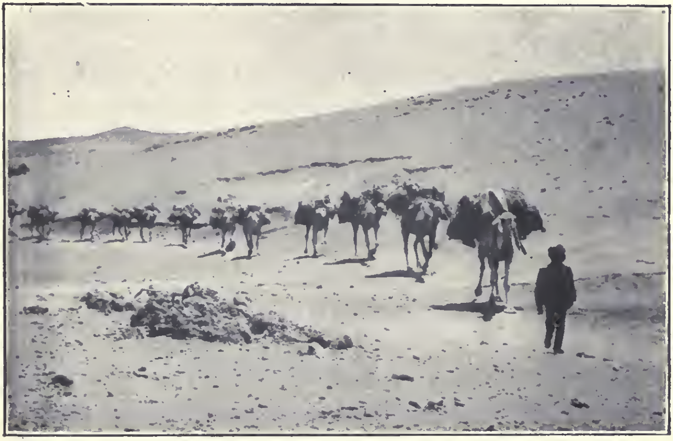
In the early days most of the heavy carting was done by **bullocks.** Wood from the hills and copper from Kapunda and the Burra were brought to Adelaide by this means. Two tons of ore could be drawn by a team of six or eight bullocks in stages of fifteen or eighteen miles a day. These slow but steady draught animals are still used in hilly and rough country, as shown in Fig. 60.



A. T. Ullmann, Photo.

Fig. 60. A Team of Bullocks drawing large Boiler to the Blinman Mine, Flinders Ranges.

In 1866, Sir Thomas Elder imported 120 **camels** from India which were landed at Port Augusta and used as means of transport between distant stations in Central Australia. These answered so well that the numbers have greatly increased and are now in general use throughout the drier areas of Australia. The great merit of the camel is its extraordinary powers of endurance. It can live on desert scrub where most animals would starve, go long spells in the hottest weather without water, travel over sandy country without exhaustion; and where other travelling animals cut up roads and create dust, the broad-spreading foot of the camel makes a "pad" without raising dust and even improves the road. These useful animals are fittingly called "the ships of the desert." Camels are broken in at three years and work up to twenty-five years. They are generally used as "pack-camels," when their load averages 5 hundredweight, and with that they travel twenty miles a day; or as "riding camels" they can do sixty miles



P. A. Corry, Photo.

Fig. 61. A String of Camels conveying Copper Ore to the Blinman Smelters, Flinders Ranges.

a day for a week, forty miles for a month, and thirty miles a day for six months. They are used by station holders, mining companies, and as general carriers into the interior, or for exploration, survey, police duty, and telegraph construction. The climate of Central Australia suits the camel admirably, and they are entirely free from the diseases to which they are subject in their Asiatic home. A string of camels is seen in Fig. 61, carrying ore to the Blinman Smelters, Flinders Ranges.*

Donkeys are also well adapted to an arid climate, as they keep in good condition on desert fare where horses would starve. Teams of over twenty donkeys are not infrequently seen in the Far North where they are harnessed to waggons which carry stores to distant mines, and bring back ore to the railway.

RAILWAYS (FIG. 62.)

In 1856, a railway 7½ miles long was opened between Adelaide and Port Adelaide, and shortly afterwards a railway to follow the main line of settlement, northwards, was begun. The section, as far as Gawler (25 miles), was opened in 1857, and with the development of the two important copper centres, the line was extended to Kapunda in 1860 and the Burra in 1870. The main north line was subsequently carried through to Quorn and Port Augusta, with a branch line to Port Pirie connecting at Petersburg. On the discovery of the Broken Hill lode a branch line was made from Petersburg to Cockburn, near the New South Wales border, and from thence was carried to Broken Hill (a distance of 36 miles) by the Silverton Tramway Company, and opened for through traffic in 1888.

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*See a paper on "Camels in Australia," by N. E. Phillipson, Proceedings Royal Geographical Society of Australasia (South Australian Branch), Vol. III., p. 83.

North of Quorn, settlement was, and is still, too limited to pay interest on cost. Notwithstanding this, an ambitious scheme was launched to connect the northern and southern seaboards by rail. With this end in view the line was continued north to Hergott Springs (441 miles), and ultimately to Oodnadatta, 688 miles from Adelaide, which latter section was opened in 1891. Bad seasons followed, budgets showed deficits, and government retrenchment became a necessity. The transcontinental line stopped at a point which is probably the driest and most barren of any tract of country between the two seas; but public sentiment came round to the view that, under existing circumstances, it would be a national folly to carry the railway further. Following on the Commonwealth Government acquiring the Northern Territory, the Federal Government took over the line from Port Augusta to Oodnadatta, one of the conditions being that the line should be carried northward and connect with the line coming south from Darwin, an extension that has not yet been carried out.

The eastern trunk line which connects Adelaide with Melbourne and the Eastern States, was opened in 1885. The line passes through the Mount Lofty Ranges, (necessitating the construction of nine tunnels and a viaduct which crosses a deep gully at the height of 108½ feet), and at Mount Lofty railway station reaches an elevation of 1,613 feet above sea level. Crossing the Murray at Murray Bridge,

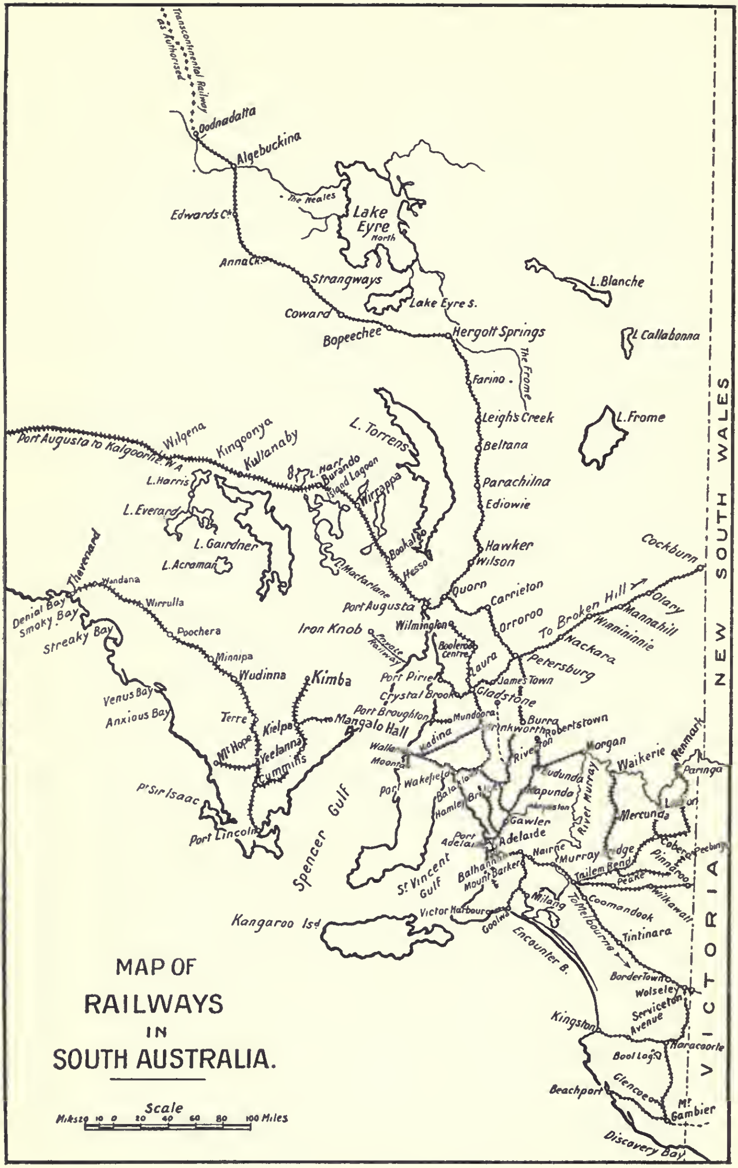


Fig. 62. Railways of South Australia.

the line passes through the plains of the Ninety-Mile "Desert," and reaches the borders of Victoria at Serviceton, 196 miles from Adelaide. Passengers can now travel by rail from Oodnadatta, in South Australia to Longreach in Queensland, a continuous line of 2613 miles.

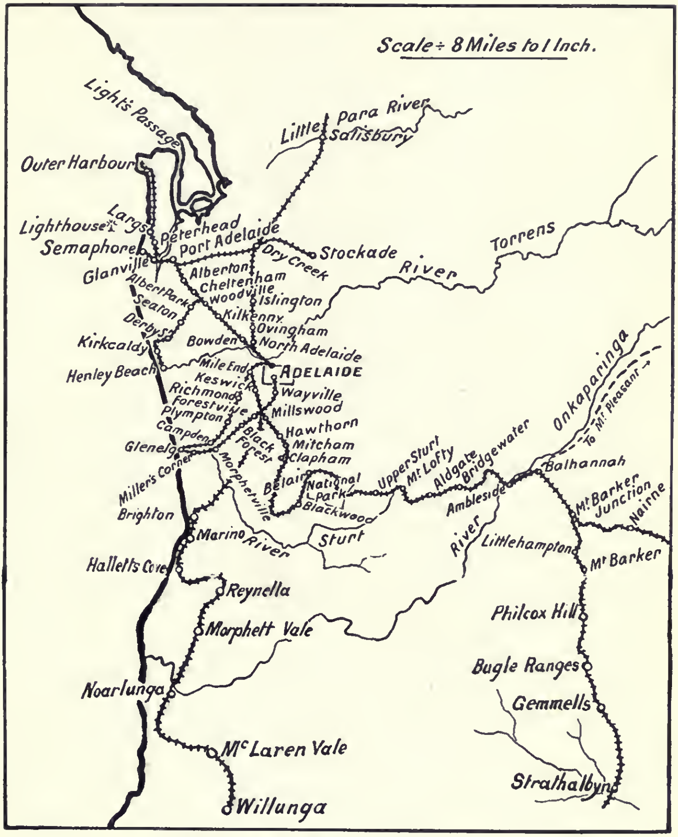


Fig 62A. Map of Railways near Adelaide.

The North-Eastern Railway leaves the main north line at Roseworthy and passes through Kapunda to Morgan, at the North-West Bend, on the River Murray, with a branch line to Robertstown.

The North-Western System, constructed on the narrow gauge, leaves the main north line at Hamley Bridge and goes by Balaklava and Port Wakefield around the head of Gulf St. Vincent to the copper-mining towns of Kadina, Wallaroo, and Moonta. A branch from Balaklava passes through Brinkworth and connects with Gladstone, on the Petersburg and Port Pirie lines; a branch line connects Kadina and Brinkworth, and a further branch line connects Gladstone with Laura, Melrose, and Wilmington.

The Port Pirie and Cockburn line of railway to Broken Hill is the busiest and best paying line in South Australia. The extensive traffic between the Barrier Mines and the coast passes over this line.

An isolated railway line, ten miles in length, connects Mundoora with Port Broughton, on Spencer Gulf.

The Southern system leaves the Adelaide and Melbourne line at Mount Barker Junction and passes due south through Mount Barker and Strathalbyn to Goolwa (on the Murray), and Port Elliot and Victor Harbour, popular resorts on the southern coast.

The South-Eastern portions of the State are served by a narrow gauge railway which has its junction at Wolseley, on the main line, five miles from the borders of Victoria. The through line goes to Mount Gambier, with branches to the coast; one of these is from

Naracoorte to Kingston, the other connects Mount Gambier with Beachport. An extension from Mount Gambier to Portland, in Victoria, has recently been opened.

The opening up for agriculture of the plains on the eastern side of the River Murray, has led to a great development of railway facilities in that direction. Tailem Bend, on the Adelaide to Melbourne line, has become an important junction for branch lines on the Murray Plains. Two of them tap the Victorian border, one at Pinnaroo and the other at Peebinga; while three others find their termini on the River Murray at Waikerie, Loxton, and Paringa (Renmark).

Suburban lines to the coast run to the Semaphore, Largs Bay, The Grange, Henley Beach, Glenelg, and Brighton, the line being continued southward from the last-named town to Willunga.

Of late years an attempt has been made to utilise the vast region of Eyre Peninsula for agricultural purposes, and, to promote settlement, railways have been constructed from Port Lincoln in various directions. One of these goes from Port Lincoln, in a north-westerly direction, meeting the coast at Thevenard (Denial Bay), a distance of 370 miles, with a branch line on the western side to Mount Hope. Another line goes in a north-easterly direction from Port Lincoln, towards Lake Gilles, to Kimba, a distance of 152 miles, while a branch from this turns eastward, to Mangalo Hall, situated to the westward of Franklin Harbour.

A great drawback in South Australian Railways is the existence of a broad gauge (5 feet 3 inches), on some lines, and a narrow gauge (3 feet 6 inches), on others. The latter was adopted on the score of economy and exists on the North-Western System, from Hamley Bridge; on the Northern System, from Terowie; and on the South-Eastern, from Wolseley. As the traffic increases the inconvenience and expense of this break of gauge become more and more felt, and will require, some day, the establishment of a uniform gauge throughout the State.

The greatest work in Australian railway construction was undertaken by the Federal Government, in the making of a line from Port Augusta to Kalgoorlie, in Western Australia, covering a distance of 1,063 miles, and by this means has established railway connection between all the respective capitals of the mainland. The work was carried out by the Government with day labour, was opened for traffic in 1917, and cost to date for construction £6,441,496. As this railway is important from a strategic standpoint, the South Australian Government is now constructing a broad gauge, direct railway, from Salisbury to Port Augusta, to link on to the east-west line, and the section from Salisbury to Long Plains, a distance of 35 miles, has already been completed and opened to the public.

With the exception of the Broken Hill Proprietary Company's ironstone-flux line to Iron Knob, on the Western side of Spencer Gulf, all the railways of South Australia (except the Federal section) belong to the State.

At the end of the financial year, June 30th, 1916, there were, in South Australia, 2,186 miles of railway in operation, and 152 miles in course of construction. The revenue for the year amounted to nearly £47,000,000, showing a profit, after deducting working expenses and interest on bonds, of £2,057.

RIVER TRAFFIC.

Australia possesses one great river which has been aptly called "The Nile of Australia." The **Murray** and its tributaries form a great arterial system of drainage of continental extent. The sub-tropical floods of Queensland, the melting snows of southern New South Wales, and the mountain torrents of Victoria, find their outlet through South Australia, where the Murray, as a time-worn river—slow, majestic, and aged—no longer capable of eroding its channel, finds its way, almost at a dead level, by a circuitous course to the sea.

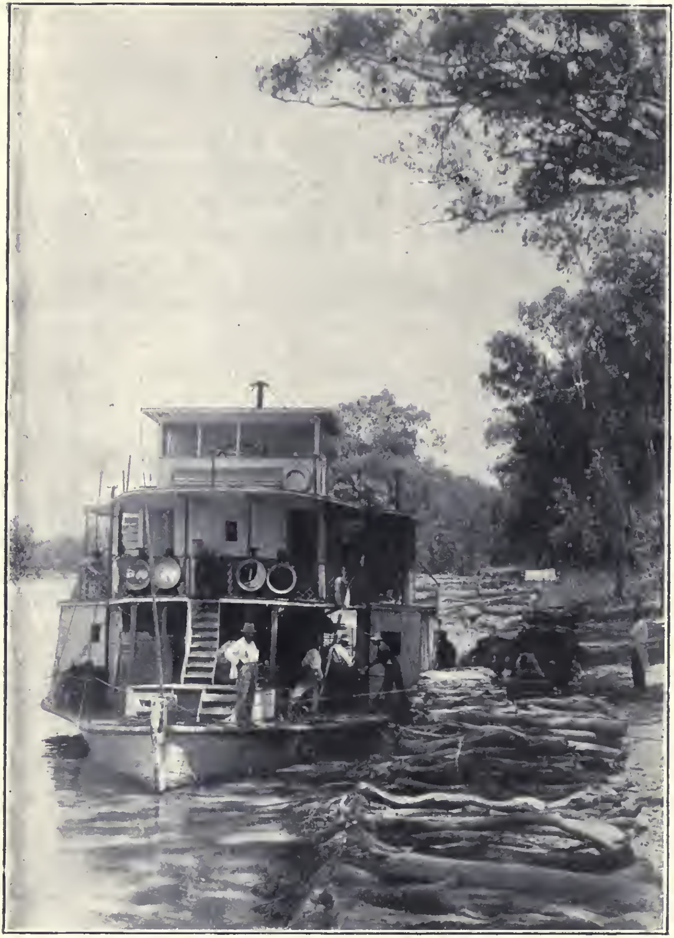
Three States, at least, claim inheritance in the river, and it has been a question of protracted diplomacy to adjust the relative claims of each. The States that are interested in the upper branches of the Murray and its tributaries require its waters chiefly for the purpose of irrigation, while South Australia requires the river for navigation as well as for irrigation. The fact that the Murray in its tortuous course from the borders of New South Wales to the sea, measures 500 miles (with a possible further 3,000 miles of up-stream waterways that could be utilised for traffic), explains why South Australians are so anxious to maintain the Murray as a navigable river.

The first cargo trip on the Murray was made from Goolwa, in 1853, by Captain Francis Cadell, as owner and commander of the paddle steamer, *Lady Augusta*. The voyage covered a distance of 1,450 miles from the sea, and the enterprising captain secured a full cargo of wool, skins, and tallow, taken in at various stations on the Murray, the Darling, the Murrumbidgee, and the Wakool rivers.

With the increasing settlement of the western districts of New South Wales and Victoria, the river trade assumed very large proportions, and several large steamers with their barges were in regular commission for passengers and cargo. In 1882 the imports of the river traffic amounted to £861,259, and the exports to £346,717. These returns have greatly fallen off of late years, chiefly through the extension of the railways to the back country and the preferential railway rates adopted by the other States to secure the river trade. (Fig. 63.)

From 1857 downwards there has been frequent correspondence and conferences between the States on the subject of the Murray waters. The increasing diversion of the upper waters by the adjoining States has been so extensive as to make possible the forecast that, in a short time, the lower reaches of the river would be reduced to a string of isolated pools or a dry sandy bed. As a consequence, the question of riparian rights became a very serious one in South Australian policy, and in 1902, a River Murray League was formed in Adelaide "for the purpose of co-operating with similar associations at Renmark and elsewhere in guarding the rights of South Australia to a reasonable use of the waters of the Murray for navigation and irrigation."

The South Australian Government was on the verge of taking steps to secure a legal injunction to stay further appropriation of the waters of the river, when



Govt. Photo

Fig. 63. Steamboat for Passengers and Cargo on the River Murray.

happily this was rendered unnecessary by the conciliatory spirit manifested at the conference of interstate Ministers, met to discuss the subject at Hobart in 1905. At a Conference of State Premiers held in Sydney, in 1906, an agreement on the subject was arrived at and signed by the Premiers of New South Wales, Victoria, and South Australia. By mutual compromise they reached a conclusion to which they could all agree, but this agreement had to be submitted to their respective legislatures for ratification, but this ratification was withheld for a number of years and was consummated only in 1915, as related above.

Under existing conditions, the Murray above Blanchetown is navigable only intermittently, depending upon the amount of rain and snow which fall on the northern and eastern watersheds of the continent. In seasons of deficient rainfall the steamers have sometimes to be laid up for months on account of the lowness of the water. The urgently needed system of locks that are now projected will conserve the water and make the river permanently navigable, and if this upstream development be followed with improvements at the mouth of the river, so as to provide a safe and adequate entrance for sea-going vessels, this noble river may become one of the great highways of commerce for Australia.

Mail and passenger steam boats run according to fixed time tables from Milang across Lakes Alexandrina and Albert to Meningie, and between Goolwa, Murray Bridge, Mannum, and Morgan, and when the depth of water permits, to stations higher up the river. Cargoes of grain, wool, fruit, skins, tallow, and other produce, come down stream and supplies are carried back by the steamers to the settlers along the river. There are "hawking" steamers which carry on a general trade, and a number of small craft used for carrying wood, etc. The river trip is becoming increasingly popular for pleasure seekers, the climate between March and October is perfect, game is plentiful, and the scenery varied and attractive.

REFERENCE.

DAVID J. GORDON.—The "Nile" of Australia, Nature's Gateway to the Interior. Adelaide 1906

SHIPPING.

The two great inlets of the sea on the southern coast of South Australia secure not only a greater extent of seaboard but also large areas of comparatively quiet waters eminently adapted for coastal trade. Moreover, the coast is washed by the waters of a great and open ocean and the tides have only a moderate height, seldom exceeding eight feet. What are locally known as "dodging" tides occur at the time of neap tides, when the rise or fall of the water is very slight, and the sea may remain practically at the same level for hours, or even a whole day; and for several days, before and after, the tides are very uncertain. This effect is produced by the solar and lunar tides at that time being opposed to each other and thereby neutralising each other. The height of the tide is often greatly influenced by the wind and barometric condition of the atmosphere, either accelerating or retarding the tidal wave. Under extreme conditions, the spring tide at Port Augusta, in the narrow channel at the head of Spencer Gulf, has been known to rise four feet above its normal height.

In the early days of the colony it was the oversea class of shipping which did business in South Australian waters, and this came almost exclusively from the Mother Country, bringing immigrants, supplies, machinery, and general goods. The voyage was by the Cape in old-fashioned, wooden, sailing vessels, many under 500 tons burden, and few made the voyage under four months.

The evolution of the ocean-going shipping passed through successive stages. The first type was the wooden, broad-bowed, slow-going vessel, that carried a small freight and executed its commission in a very leisurely fashion. These were displaced by an improved sailer having an iron frame-work and wooden planks. Then came the "clipper" with its steel-plated hull and sharp bows, designed for greater speed as well as greater carrying capacity. Finally, the steamship, the first of a new fleet destined to drive all other competitors from the waters, arrived in South Australia in 1852.

The intercolonial shipping trade was established soon after the settlement of the colony, and this is still the principal method of intercourse between South Australia and her sister States. The regular ocean-going mail steamers, and various other English, French, and German shipping companies, supply facilities for interstate communication, as well as means of travel and export to more distant parts of the world. The ownership of Australasian shipping is divided among many strong companies and is rapidly expanding.

The coastal steamer traffic is mostly confined to St. Vincent and Spencer Gulfs. Of late years a larger class of steamers with improved accommodation for passengers has been employed on these lines. The chief places of call from Port Adelaide are Ardrossan, Port Vincent, Stansbury, Edithburgh, Kangaroo Island, and Port Lincoln. Cargo boats visit many places in both Gulfs, and along the Western Coast to Elliston, Venus Bay, Streaky Bay, Denial Bay, Point Sinclair, etc. A round trip is made for passengers, etc., calling at Port Lincoln, and all the principal ports in Spencer Gulf. There is also regular steamboat communication between Port Wallaroo and Port Lincoln, Tumby Bay, Franklin Harbour, and other places in Spencer Gulf.

Postal System.

In the early days of the colony all letters to and from Adelaide were sea-borne, and Thomas Gilbert, the colonial storekeeper, acted as the receiver and distributor of all letters. A uniform charge of one penny was made for each letter, and the amount thus received was paid over as a gratuity to the captain carrying the letters. A government post office was established in 1839, when a charge of threepence per letter or packet was made irrespective of weight or size. Some persons took advantage of such uniform rates and sent by post such articles as a chest of tea or other bulky packets. A revision was made in 1841, when inland letters were charged according to distance (still irrespective of weight), up to a maximum of 2s. 6d. In 1845 the inland postage rates were reduced to a uniform charge of fourpence for each half-ounce, a preference rate being fixed for suburban and Port Adelaide letters, which were carried for half the above sum. Later, a uniform charge of twopence for each letter of half-an-ounce was established for the colony as a whole. The first regular steam-packet service with England was established in 1852, when a time limit for the mail service was fixed at 68 days between London and Adelaide. Postage stamps were introduced in 1855. The present postal system is very complete but somewhat costly on account of the scattered population in the outlying areas of settlement. The State postal department became merged in the Commonwealth postal system in 1901, and penny postage for letters not exceeding half-an-ounce was introduced in 1911.

Telegraphic Communication.

The South Australian telegraphic system was the first in Australia to establish direct communication by cable with the world at large. The cablegrams which appear in the daily papers of all the States, and which give us information of what is going on in all parts of the world, are being transmitted almost hourly by means of the **Transcontinental Telegraph,** connecting Adelaide with Darwin, a distance of 1,975 miles. This great national undertaking was accomplished mainly through the foresight and energy of Mr. (Sir Charles) Todd, the first Superintendent of Telegraphs in South Australia. He was an assistant at Greenwich Observatory to the then Astronomer Royal (Sir G. B. Airey), by whom he was recommended for the post of Superintendent of Telegraphs and Astronomical Observer to the South Australian Government. Mr. Todd entered on his duties in 1855, and shortly after his arrival in Adelaide the first government telegraph was established which connected Adelaide with the Port.*

In July 1856, Todd visited Melbourne to confer with the Victorian Government with reference to establishing telegraphic communication between **Adelaide** and **Melbourne**. Having secured the co-operation of the sister colony, Todd returned overland for the purpose of selecting the route for the line. The line was opened in 1858, the construction having cost a little under £20,000. Later in the same year the line was carried through from Melbourne to Sydney, and in 1861 to Brisbane. An overland line, direct to **Sydney,** *via* Wentworth, was opened in 1867.

With the rapid development of intercolonial telegraphic communication the next step was to establish a connection by cable with outside systems. But the Where? and How? were difficult questions to answer. As early as 1857 Todd suggested an Overland Telegraph from Adelaide to the northern coast of Australia, and in 1859 he officially reported to the Governor, Sir R. G. MacDonnell, on the subject. The latter submitted the proposal to the Secretary of State, and there it rested for a few years. In the meantime an English Company, in 1862, issued a prospectus for connecting Java by cable with Moreton Bay, and the Australian Colonies were asked to guarantee a subsidy of £50,000 per annum for thirty years. Todd, in reporting on the scheme, strongly urged a transcontinental line as being more desirable and less costly. John McDouall Stuart's successful journey in penetrating the continent from south to north greatly strengthened the recommendations of the Superintendent of Telegraphs, which he further urged in his Report of 1863.

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*A privately owned telegraph had been opened between Adelaide and Port Adelaide by Mr. James MacGeorge a short time before the Government line, but was bought up by the Government.

The question was brought to a crisis in 1870 when a naval officer (Commander Noel Osborne) visited Adelaide as the managing director of an English Company, for the purpose of obtaining government sanction to land a cable at or near Darwin and construct a line thence through South Australian territory to connect with the Queensland telegraph system at Normanton. Mr. Todd, in interviews with Commander Osborne, urged a through line to Adelaide, which was warmly supported by Mr. Strangways, as head of the Government, who offered on behalf of the South Australian Government to construct an overland telegraph from Port Augusta (which was at that time the northern terminus of the South Australian system), to Port Darwin, and thus relieve the company which Commander Osborne represented of any trouble or charge with reference to land lines. A change of ministry occurred about the same time, but the country was enthusiastic with reference to the project. A bill, authorising the construction of the overland telegraph, was passed, and the work completed in less than two years, communication being established with England on October 21, 1872.

The route followed closely that taken by the explorer Stuart and covered a distance of 1975 miles. The work involved enormous difficulties, heavy costs, and was undertaken when the population of the colony numbered only 200,000. The total cost amounted to about half a million sterling, and this was much heavier than it would otherwise have been in consequence of the ravages of white ants necessitating, at an early date, the substitution of iron poles for the wooden ones over the greater portion of the track. The facilities given by this means have been of inestimable value to the community in the promotion of intercourse, stimulating trade, and bringing the public, generally, into touch with the daily pulsations of the civilized world—privileges which the whole of Australia immediately shared in common.*

Next in magnitude to the transcontinental line to Darwin was the **overland telegraph to Albany** (Western Australia), around the head of the Great Australian Bight, where Eyre, in 1840, suffered such privations. The Western Australian Government connected by wire at Eucla, and the South Australian line was carried thence from Port Augusta, *via* Port Lincoln, a distance of 759 miles. The work was completed in July 1877, at a total cost (for South Australia) of £68,205, and was the last section in the circuit by which all the capitals of the Australian mainland were brought into telegraphic connection.

Submarine Cables.—A cable is laid between Darwin and Banjoewangie, in Java, connecting with India, Eastern Asia, and Europe. Another is laid between Adelaide and Fremantle and is continued thence to Durban in South Africa. There is also a duplicate cable to Banjoewangie, starting from the West Australian telegraph system at Broome, in Roebuck Bay. All the above mentioned submarine cables are owned by the Eastern Extension Telegraph Company. If we add to these the Pacific Cable, the

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*See interesting accounts of the construction of The Trans-Australian Telegraph in Harcus's "South Australia," (1876), p. 58; also in Worsnop's "History of the City of Adelaide," p. 351; and Hodder's History of South Australia, 1893, Vol. II, pp. 22-23.

"All Red" route, uniting Queensland (Southport) and Canada, *via* Norfolk Island, Fiji, and Fanning Island, it will be seen that there are now **four** cable connections between Australia and Europe, so that the telegraphic isolation of Australia is now almost impossible.

CHAPTER VIII.—EXPORTS AND IMPORTS.

Produce was first exported from South Australia in 1838. Wheat was first shipped in 1839, and minerals in 1842. During the first ten years of the colony's history the **exports** were mainly wool. In the second decade the minerals (chiefly copper) overtook and outstripped in value those of both wool and wheat. In 1856 (twenty years after the founding of the colony), the three staple articles, wool, wheat, and minerals, had each reached an export value that may be roughly represented as about half-a-million pounds. But from that date, wool and wheat took a decided lead and remain to-day as the staple exports of the State. (Fig. 64.)

With respect to **produce**, such as frozen meat, fruit, butter, eggs, etc., the export industry is of comparatively recent date and must be regarded as still in its infancy. With the rapid development of the pastoral and producing interests it became imperative that an export trade for produce should be secured and developed. In times of glut, not only did the prices fall to a ruinous figure, but it sometimes happened that the only return the pastoralist could get for his sheep was to save the skins and send the carcases to a boiling-down establishment or burn them in heaps, a state of things which, if permitted to continue, would have paralysed the industry.

Under such critical conditions the Government came to the assistance of the producers. In 1895 a Government Produce Export Department was established for the purpose of opening up oversea markets for the products of the State. Freezing works were built, and shipments of frozen lambs, rabbits, poultry, butter, eggs, wine, honey, fruits, etc., were, until interrupted by the war, regularly despatched by the Department. The Government Depôt at Port Adelaide is very extensive, and capable of treating 8,000 lambs per day. This is quite independent of a large and increasing export trade carried on by private enterprise.

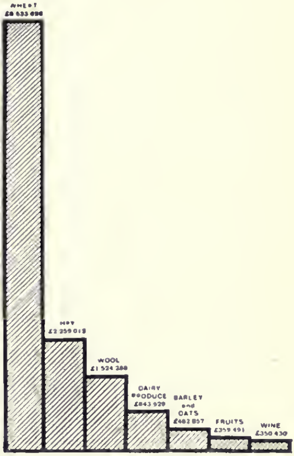


Fig. 64. Comparative Values of principal Agricultural Productions of South Australia, Season 1915-16.

Although the Government Export Department has so far made only a small financial profit in its operations, it has been the means of exporting produce up to 1916, to the value of nearly three-and-a-half millions sterling. The main profits have been of an indirect character by stimulating the producing industries of the State, obtaining better and more regular prices, and establishing confidence with respect to obtaining markets for perishable products.

EXPORT AND IMPORT TRADE OF SOUTH AUSTRALIA.

The great drought that culminated in 1914, together with the effects of the war on international exchange, has greatly interfered with Australia's oversea trade, so that the latest available statistics are, generally speaking, much below the normal values. Wheat is South Australia's most valuable article of export, and wool makes a good second.

Comparative Values of Some of the Principal Exports of South Australia for the Season 1915-16, are given below:—

Wheat ..	£1,440,682	Meats	£56,790
Wool ..	1,412,104	Fruits	48,323
Flour ..	314,808	Wine	38,987
Skins, hides & leather	224,713	Butter	6,506

Total value of direct oversea **exports** for the season 1915-16, £6,136,085.

Total value of direct oversea **imports** for the season 1915-16, £5,152,200.

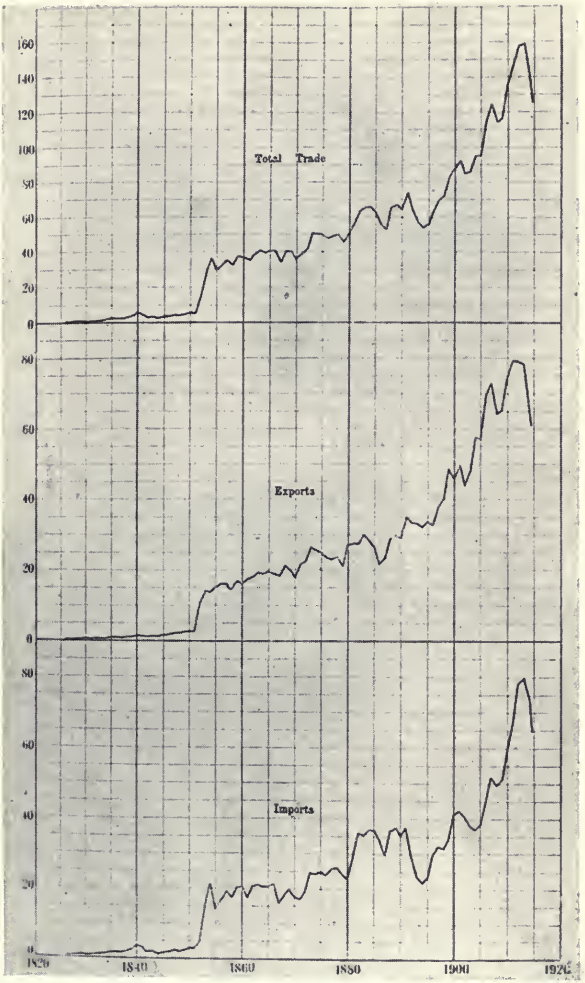
Destination of Exports for the Year mentioned:—

The United Kingdom took £2,633,628; per centage, 46.95.

Other British Possessions took £758,263; per centage 13.91.

Foreign countries took £2,744,194; per centage 39.14.

Fig. 65. GRAPHS SHEWING VALUES OF TOTAL TRADE, EXPORTS & IMPORTS OF COMMONWEALTH, 1826 to 1915.



Explanation of Graphs. The base of each square represents an interval of five years, and the vertical height five million pounds sterling for Imports and Exports, and ten million pounds sterling for Total Trade.

During the twenty-five years immediately preceding the war the oversea trade of Australia increased greatly. Germany advanced her trade with Australia in that time 27½ per cent., the United States, 23 per cent., and the United Kingdom, 18 per cent. It will thus be seen that foreign countries are apparently increasing their trade with Australia at a greater rate than the Home Country; but it must be remembered that the trade of the non-British countries with Australia twenty-five years ago was very much smaller than that of the United Kingdom, so that the relative increase of imports in the case of foreign countries is not so great as it might appear at first sight.

CHAPTER IX.—POPULATION.

At the close of the year 1915 the population of South Australia (exclusive of aborigines), was estimated at 439,660.* Of this number considerably more than a third live in Adelaide and the immediate suburbs. By taking in a wider suburban area that would include Port Adelaide and the adjacent districts, within a seven miles radius, we get a total of 200,000, or about half of the entire population of the State. This might be regarded as an unfavourable condition of things for the development of the country. The capital city is mainly the centre of administration, of exchange, commercial agencies, and financial institutions, which are all primarily dependent on the producing capabilities of the country. To maintain a healthy and progressive condition, the sources of production and the administrative agencies should be fairly balanced. A similar segregation of population is seen in the capitals of the eastern States, as both Melbourne and Sydney contain more than one-third of the entire population of their respective States.

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*In 1914 the population of New South Wales was 1,861,522; Victoria, 1,430,667; Queensland, 676,707; Western Australia, 323,018; Tasmania, 201,416; Northern Territory and Federal Territory 5,932. The Commonwealth, 4,940,952.

This unequal distribution of the people in Australia may, in some measure, be explained by the physical features of the country and the nature of its staple products. Corn and wool require wide areas for their production, with a corresponding low percentage of population to the square mile. The limitation of rainfall, which exists in the greater part of South Australia, is not favourable for intense culture, and the absence from its natural resources of what would give a cheap motor power, militates against the establishment of manufacturing centres. At the same time there are great possibilities in the country, which, in the near future, may be expected to double its population, and still leave ample room for further development.

The people of South Australia are distinctly British in their **origin.** The foundation of the colony was deliberately planned and the immigration, for some time, was controlled by a Board sitting in London. No gold rush or mining fever has attracted a miscellaneous crowd to its shores. The population has grown by a steady stream of immigrants, gathered mostly from the mother country, and the natural increase from this stock.

The only marked exception to this rule was in the introduction of a considerable number of German immigrants by the late George Fife Angas. The occasion arose from the persecution of a dissenting sect of Lutherans, who refused to accept a new liturgy framed by the king (Frederick William III). G. F. Angas was so moved by the story told by one of their ministers (Pastor Kavel, of Klemzig), that he placed the whole of his available wealth at the disposal of the persecuted people for their emigration to South Australia, the money advanced in this scheme to be refunded in instalments, after the emigrants had settled on the land. The Lutherans formed local settlements which became essentially German villages. Mr. Angas continued to show a paternal interest in these fugitive people, and incurred large financial responsibilities in providing for their necessities. This was done from the highest motives on the part of Mr. Angas, and did not always command the gratitude it deserved. Indeed, Pastor Kavel, who had emigrated with his flock, had to adopt the extreme measure of refusing the Sacrament to those of his congregations who were not doing their duty in the repayment of their debts to their benefactor; and it is said, in consequence, "for a time, he was a pastor almost without a flock."* The lesson was salutary and effective.

In the course of a few years 8,000 Germans came to South Australia as specially assisted emigrants. They have made useful colonists, and the villages of Blumberg, Greenock, Grunthal, Hahndorf, Lobethal, Lyndoch, Nuriootpa, Angaston, Rosenthal, and

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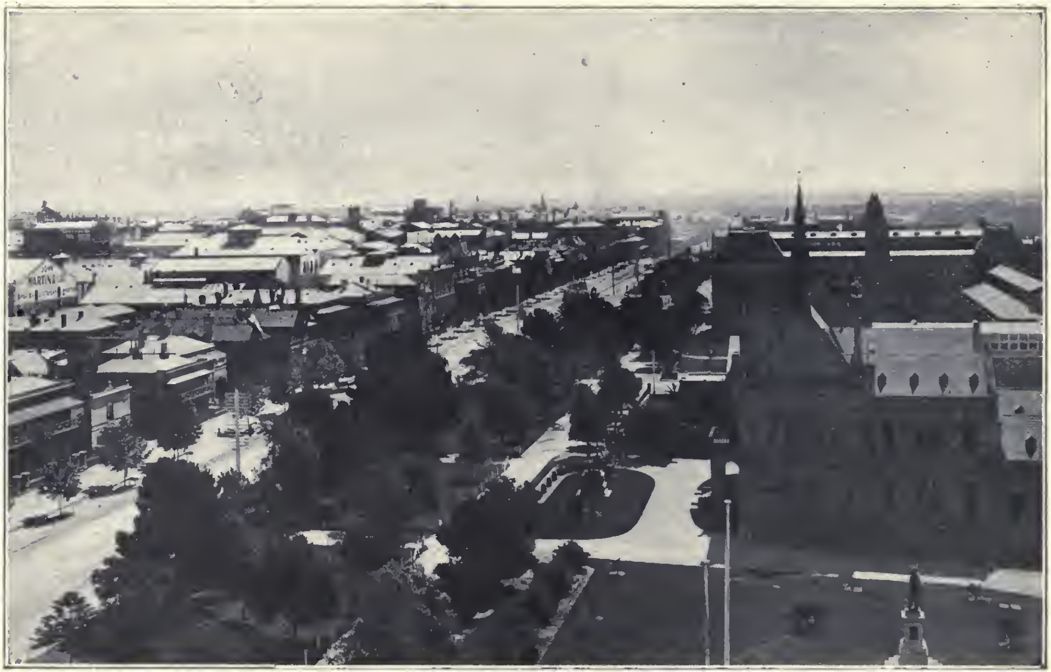
* Hodder's Life of George Fife Angas, p. 193.



Govt. Photo.

Fig. 66. View on North Terrace Adelaide, including the University, Public Library and other Public Institutions.

Tanunda, were local centres where the pioneer Germans settled, and these subsequently attracted many of the same nationality who emigrated under other conditions.

For many years the South Australian Government adopted the principle of **State-aided immigration.** On the discovery of gold in large quantities in Victoria many immigrants took advantage of the South Australian immigration provisions as a cheap method of getting to Victoria, and for this reason, the Government, for some years, discontinued the system. Later, in 1861, immigration by State-aid was resumed. Suitable emigrants, who paid their own passage, received in London a land-order warrant of the value of £20 for each adult and £10 for each child between the ages of one and twelve years. Artisans, labourers, miners, gardeners, and domestic servants could obtain "assisted emigration," the cost of the voyage being divided between the emigrant and the South Australian Government. All State-aided emigration ceased in 1886. The number of assisted immigrants by State aid in South Australia totalled about one hundred thousand.

At the last census (1911) the following non-British born persons were reported as residents in South Australia, viz., Germans, 4,977; other European nationalities, 2,678; American (North and South), 533; Chinese, 242; other Asiatics, 287; Africans, 18; Polynesians, 18; aborigines, 1,439;* half-castes, 692.

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*Aborigines living in a purely wild state were not enumerated.

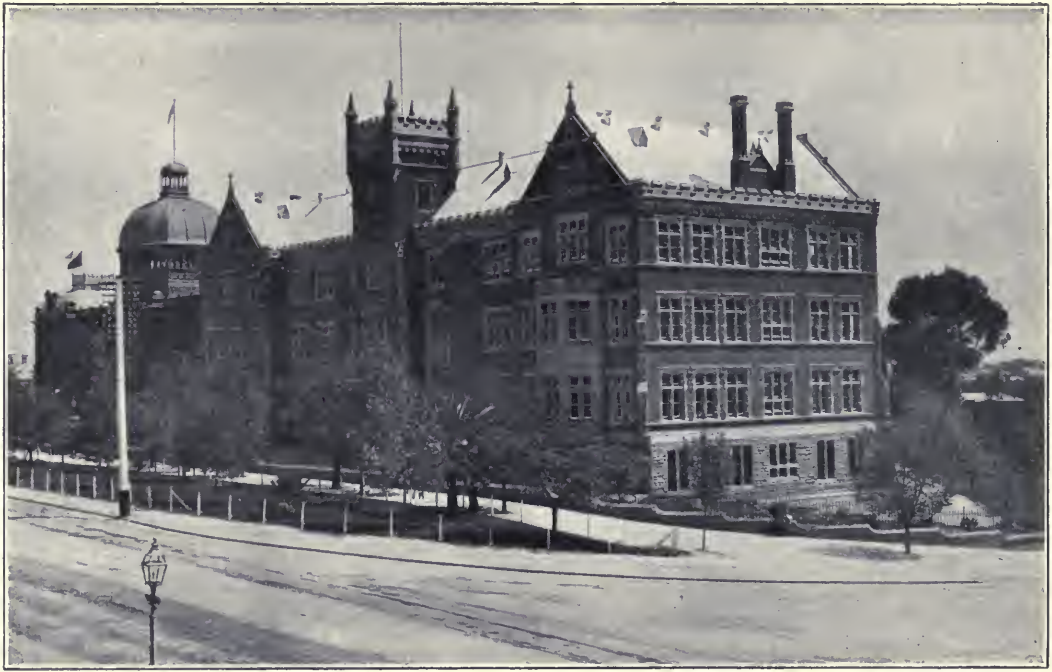

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Fig. 67. School of Mines and Industries, Adelaide.

In the following table the relative density of population to the square mile in various countries is shown:—

Country.	No. of Persons per Square Mile.	Country.	No. of Persons per Square Mile.
United Kingdom ...	378.72	Tasmania	7.38
German Empire ...	324.80	New South Wales ...	5.32
France	191.74	Canada	2.17
United States	33.22	Aust. Commonwealth	1.69
Russia	14.9	Queensland	0.90
Victoria	15.0	South Australia ...	1.08
New Zealand	11.07	Western Australia ...	0.29

CENTRES OF POPULATION.

Adelaide and its Suburbs.

The capital of South Australia (Fig. 66) is situated about mid-way between the sea and the base of the Mount Lofty Ranges, on a coastal plain which is, at this point, eleven miles wide. The city occupies gently rising ground, and is divided into two parts by the valley of the River Torrens which, as a belt of park lands, separates North Adelaide from the main part of the city on the southern side. Few cities have had the same advantage as Adelaide in their origin, as its site was deliberately selected and the city planned out before a single permanent building was erected in it.

It was fortunate that, in this case, the responsibility rested with an officer so capable and far-seeing as Colonel Light (Fig. 68), the Surveyor-General, who was charged by the Board of Commissioners in London with full powers to "determine the site" of the capital, and "to lay it out" with due regard to the prospective needs of a great country. Colonel Light selected the site in 1837, but his choice met with determined opposition in influential quarters,

Fig. 68. Colonel Light, the First Surveyor-General of South Australia.

and though he conscientiously held to his decision, this and other matters of friction in his official relationships, led him shortly afterwards to resign his position. Colonel Light's appeal to posterity to

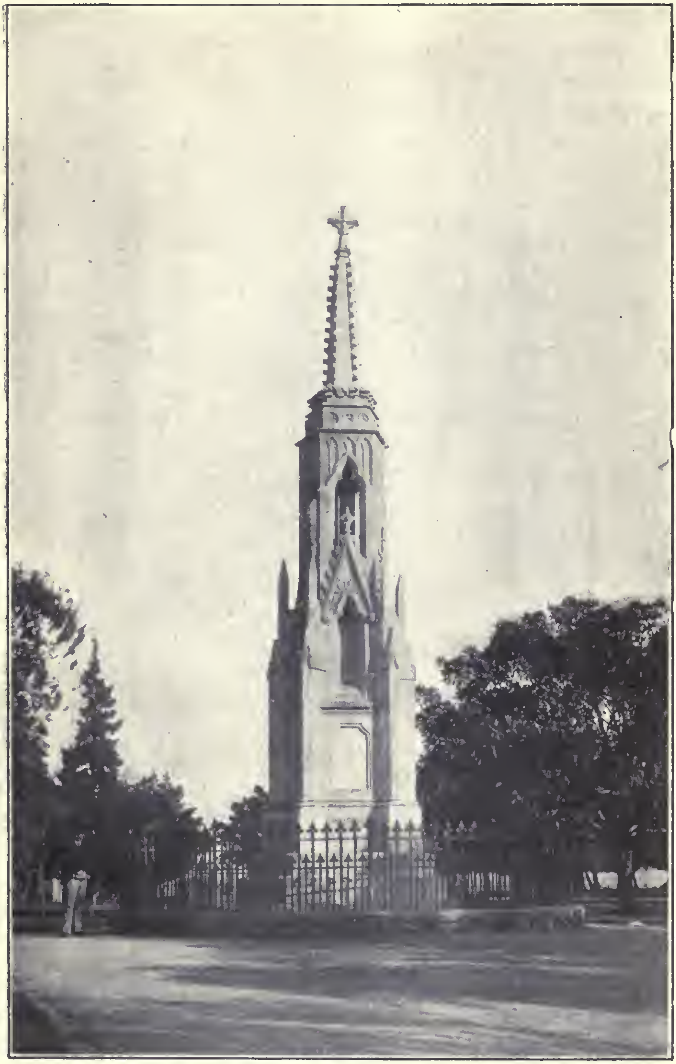

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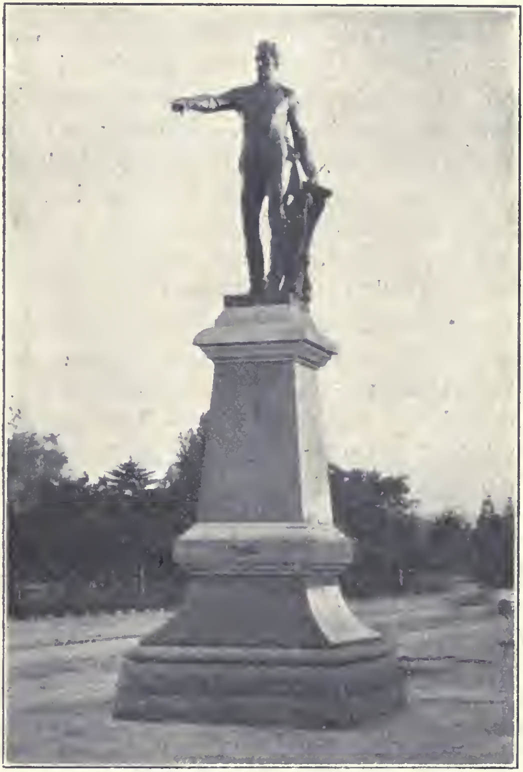
Fig. 69. The Original Monument placed over Colonel Light's Grave, Light Square, Adelaide. (This Monument has of late years been replaced by another of different design).

endorse his judgment in the selection of the site for the capital has, long since, been justified by general approval. Light lived only three years after his retirement, and was buried in the centre of Light Square under an artistic monument. (Fig. 69.) The latter falling into decay, has been replaced in recent years by a more substantial memorial, and



Donald Taylor.

Fig 70. Statue of Colonel Light, Victoria Square, Adelaide.

a striking statue in bronze of South Australia's first Surveyor-General and founder of Adelaide, was erected in Victoria Square, in 1906. (Fig. 70.)

The capital of South Australia was named after Queen Adelaide, the wife of William IV., the reigning monarch at the time the province was founded. Few cities possess so large a proportion of breathing space as Adelaide. The city is laid out in rectangular blocks, with a large central square and four other squares at equal distances, in the four quarters of the city. Surrounding South Adelaide and North Adelaide, as well as between these divisions, is a belt of park lands about half a mile in width. The squares and park lands are tastefully planted and reserved for public recreation. A weir crosses the river a little to the west of the city, and impounds the water, forming the Torrens Lake, a fine stretch of water two miles in length. This adds greatly to the artistic features of the city and affords excellent opportunities for boating. The Botanic Gardens, the Botanic Park, and the Zoological Gardens are sections of the park lands which have been devoted to special uses for public education and entertainment.

The city and park lands together, cover nearly six square miles. On this plan, the city of Adelaide, enclosed by the beautiful belt of trees and flowers, is strictly limited in size for all time, and is becoming more and more a purely business centre, whilst the residential areas enclose the zone of Park Lands on every side. This Greater Adelaide takes in a radius of about six miles and includes seven Municipal Corporations and ten District Councils, in addition to Adelaide proper. The whole of this extensive area must, in a sense, be regarded as metropolitan, as the respective suburbs are for the most part, included in a common system of lighting, deep drainage, water supply, and the various municipalities have combined to form one Electric Tramway Trust.

The sanitary condition of the metropolitan area is of a very satisfactory character. There is little crowding, even within the limits of the city, and most of the houses have gardens. Wooden structures are prohibited, and as excellent building stones can be got in unlimited quantities within easy distance from Adelaide, the buildings throughout the area are of a substantial character. The position of Adelaide, with sloping ground all round presents very favourable conditions for drainage. A very complete and successful system of deep drainage is general throughout the Metropolitan area, connections are compulsory with all inhabited buildings, and the sewage is used at a farm a few miles north of Adelaide. Only storm waters are permitted to run over the surface, all other forms of drainage find their way down into the deep drainage forming an automatic flush in cleansing the pipes. The water supply is of good quality, ample, and is charged for on rateable value, with a low price for excess quantities. The tramways, until 1909, were worked by horse traction. The conversion of the system was deferred for a number of years through want of unanimity as to whether the works should be privately owned or carried out by the municipalities concerned. Finally the latter undertook the

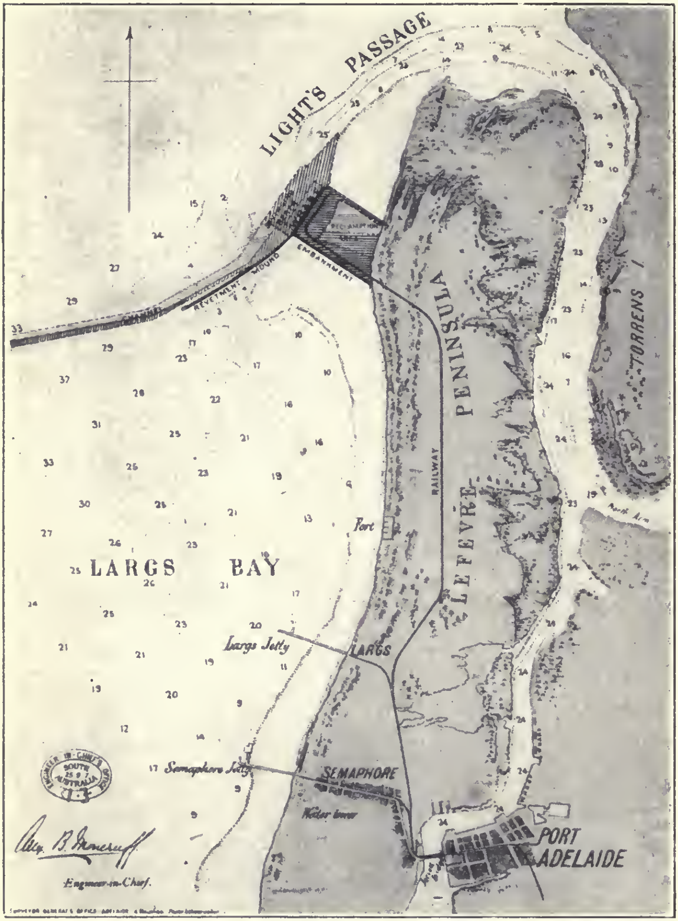


Fig. 71. Map of the Port Adelaide River including the Outer Harbour, in Light's Passage, at the entrance to the River.

work and an up-to-date electric system is now in operation.

PRINCIPAL SEAPORTS.

Port Adelaide.—(See Frontispiece). The chief port of South Australia is distant 7½ miles from Adelaide and was surveyed and laid out at the same time as the latter. It is situated on an inlet of the sea, usually called the Port River, which in its present restricted channel represents the deeper portions of an old estuarine area many square miles in extent. A recently constructed outer harbour, (Fig. 71) near the mouth of the "river," has been designed specially for the convenience of the large

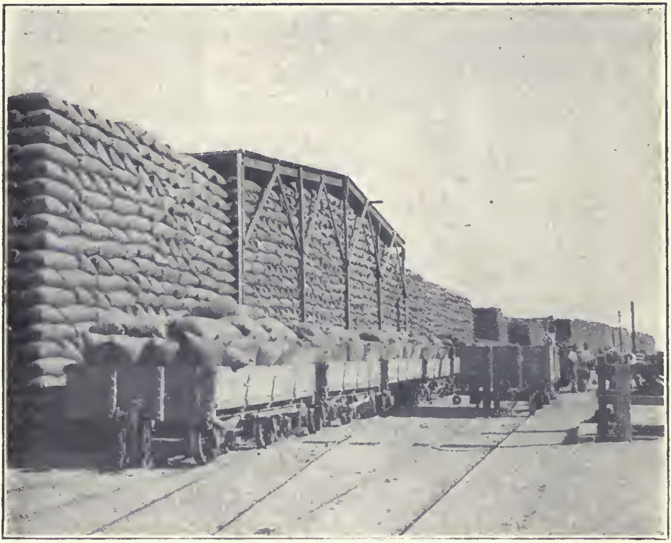


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Fig. 72. Stack of Wheat, containing 160,000 bags, on the Quay at Port Wakefield, in process of Shipment.

mail steamers, which are now able to land passengers, mails, and cargo direct on to the wharf, instead of at the anchorage, which in rough weather was a very disagreeable experience. In the inner harbour there are about 2½ miles of wharves, with a depth alongside of from 10 to 27 feet at low water. The stream is navigable for large vessels to above Jervois's swing bridge, 8½ miles from the mouth. Port Adelaide is the principal inlet and outlet of the oversea trade of the State, has a population of over 24,000, and has been constituted a city.

Port Wakefield, situated near the head of St. Vincent Gulf, is a convenient port for the shipment of wheat from districts in the Lower North. (Fig. 72.)

Port Pirie, is situated on an inlet of the sea, on the south side of Germein Bay, Spencer Gulf. The port is near the head of the inlet six miles up from the sea, the intervening space being occupied by mangrove swamps. The channel has been improved to give a depth of 15 feet at low water, with a mean rise of nine feet at high tide. Vessels of 4,200 tons have navigated the waterway. It is the shipping port for the Broken Hill (N.S.W.) mines, and the large smelting and desilvering works of the latter are in operation at the Port. The imports are chiefly coal, coke, timber, limestone, and ironstone flux, whilst the exports are ores, bullion, wheat and wool. Population 10,700. (Fig. 73.)

Port Germein, is situated at the north side of Germein Bay, ten miles from Port Pirie. The harbour consists of an "anchorage" and a jetty, the latter 5,459 feet in length. Dredged berths are pro-

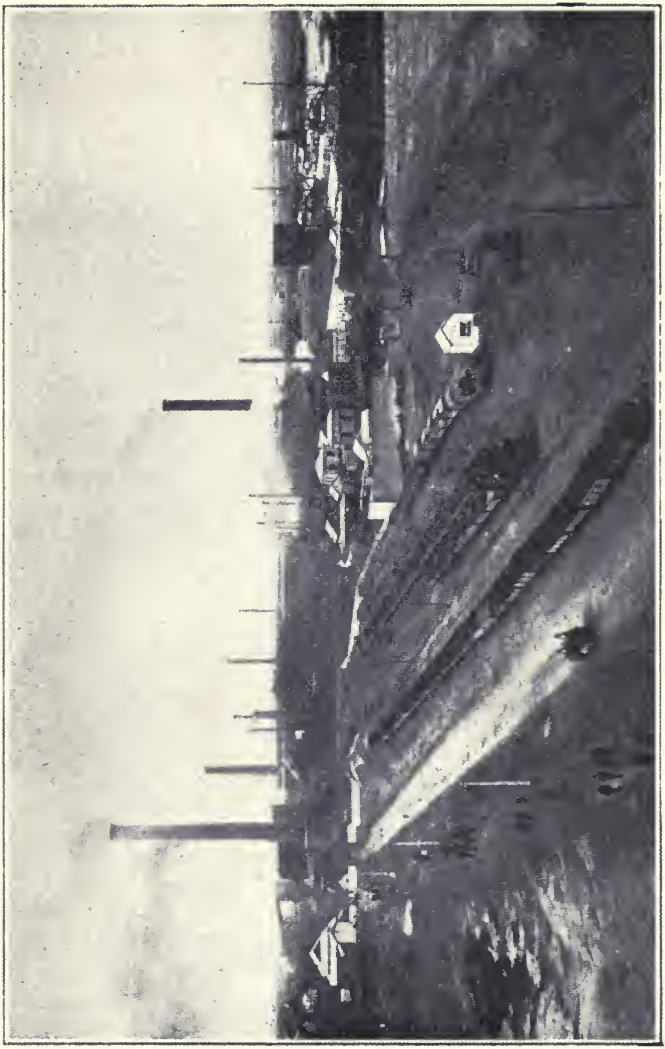

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Fig. 73. Port Pirie, showing Smelting Works for the Ores of Broken Hill.

vided for three vessels with from 20 feet to 23 feet at low water. It affords a convenient port for the export of wheat and wool from the adjacent back country.

Port Augusta, at the head of Spencer Gulf, possesses a fine commodious and safe harbour, with a good depth of water. There is a substantial wharf, 1,188 feet in length, with 22 feet of water at low tide. The tide rises from nine to twelve feet. It is the port for the Far North. Imports—Coal and stores. Exports—Ores, wool, grain, etc. Since much of the northern pastoral country has been relinquished the shipping trade of the Port has fallen off considerably. A railway from Port Augusta connects with the main north line at Quorn, passing through the Pichi-richi Pass, amidst picturesque scenery with Mount Brown (3,200 feet) and the Devil's Peak, as prominent heights. Population about 1,500.

Wallaroo, is on Wallaroo Bay, on the east side of Spencer Gulf. A railway jetty, 2,100 feet long, affords berths for seven vessels, drawing up to 22 feet. It is the port for the Wallaroo and Moonta Mines, as well as the extensive smelting and other works in the neighbourhood. (Fig. 74.) The imports are chiefly machinery, timber, mineral phosphates, and general supplies; and the exports, copper, lead, wheat, etc.

Kingston, situated on the south-eastern coast, has a jetty 4,008 feet long. It is mainly a port for coastal vessels and supplies the south-east, as well as western Victoria, with general stores. Exports wool, grain, bark, and skins.

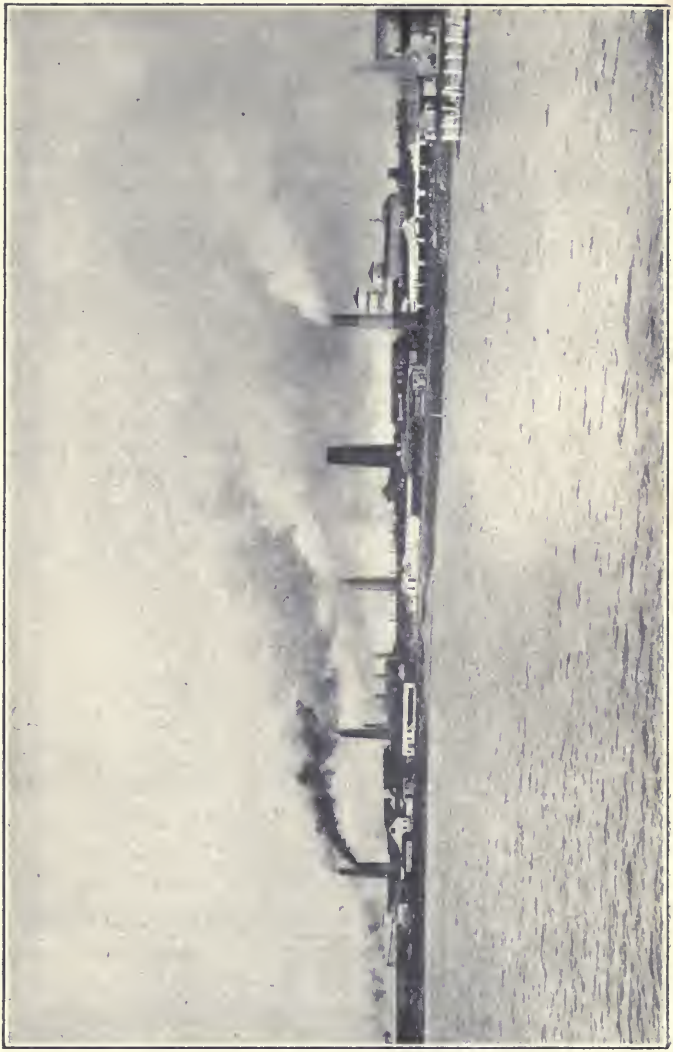

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Fig 74. Smelting Works at Wallaroo

Numerous jetties exist along the coast which afford facilities for a small amount of local shipping trade. **Cowell** is on Franklin Harbour, a very fine sheet of land-locked water, on the western side of Spencer Gulf, but the water is shallow. **Port Lincoln** is at the head of one of the finest land-locked harbours of Australia, and at the founding of the colony, the site had many advocates as suitable for the capital city. It was examined by Colonel Light on his arrival in the colony, but his practical judgment saw that the surrounding country was too poor to develop a flourishing capital at that spot. Of late years the agricultural interests of the district have markedly improved and railway facilities have opened up large areas of the back country. **Edithburgh**, on the western side of St. Vincent Gulf, is the port for the shipment of salt and gypsum, which are gathered from the numerous salt "lagoons" of southern Yorke Peninsula.

INLAND TOWNS.

Mining Towns.—The important copper mines in northern Yorke Peninsula, support a population which, in numbers, is second only to the metropolitan areas. **Wallaroo, Wallaroo Mines**, and **Kadina**, which are closely connected townships, have a united population of 5,900 mostly engaged in copper mining and smelting. **Moonta** and **Moonta Mines** (the latter the most famous copper mine in South Australia) are united in one Corporation with a population of 1,800. The **Burra**, a township on the North Line, 100 miles from Adelaide, had its origin in the discovery of the rich Burra Burra copper mine, and notwithstanding that the mine has not been in operation (except in a small way) for a number of years, the town flourishes as an agricultural and pastoral centre. **Kapunda**, on the branch railway between Roseworthy and Morgan, also owed its foundation to the discovery of copper deposits in the neighbourhood, in 1842, and was the first copper mine worked in South Australia. The mineral deposits are apparently worked out and the town is now an agricultural centre.

Manufacturing Towns.—Hindmarsh, on the western side of Adelaide, possesses tanneries and manufactures leather. **Bowden,** adjacent to the former, possesses excellent brick-earth and manufactures bricks, pipes, and general pottery; it also has factories for the manufacture of boots and shoes. **Gawler,** 25 miles north of Adelaide, pleasantly situated at the base of the hills, is a town of 3,450 inhabitants. It has extensive foundries for the manufacture of locomotives, farm implements, and mining machinery. **Ardrossan,** on the western side of St. Vincent Gulf, manufactures ploughs; and **Lobethal,** in the hills, manufactures blankets, rugs, tweeds, and other woollen goods; **Thebarton,** blankets

Agricultural Towns.—The chief agricultural towns are situated between Quorn and Adelaide. **Crystal Brook, Georgetown, Gladstone, Laura, Caltowie, Jamestown, Yongala,** and **Terowie,** occupy the high ground that forms the east and west watershed. Further south are **Saddleworth, Riverton, Clare, Brinkworth,** and **Balaklava.** On Yorke Peninsula are **Maitland, Minlaton,** and **Yorketown.**

Railway Towns.—On the northern railway **Hamley Bridge,** on the River Light, is the junction for the north-western system of railways. **Petersburg** is an important railway centre for the trunk lines running north and south, and also east and west. The heavy traffic between the Broken Hill Mines (New South Wales), and the seaboard, passes through this town. **Quorn** is the junction for Port Augusta and the main north line, and is the first day's terminus for travellers going north. **Hawker** (275 miles from Adelaide) is delightfully situated in the Flinders Ranges, has a dry clear air, and can be visited with advantage as a sanatorium. **Hergott** (441 miles from Adelaide) is on the southern edge of the great central artesian basin, and is the second day's terminus for travellers going north. **Oodnadatta** (688 miles from Adelaide) is the terminus of the northern system of railways, and the rendezvous for the camel teams which are used for transit and carriage in Central Australia.

On the southern system of railways are **Wolseley,** the junction for the south-western system; **Border Town,** the last station before reaching the Victorian border; **Naracoorte,** noted for its underground caves (see Fig. 35, p. 97), situated eight miles from the township; **Millicent,** an agricultural centre on the Mount Gambier and Beachport line; and **Mount Gambier,** until recently the terminus of the railway and the chief town of the south-eastern portions of the State. The latter is built on the lower slopes of an extinct volcano with a surrounding area of very rich soil produced by the decomposition of volcanic ash. The Mount, the sunken lakes around the base of the mountain, the temperate climate, and places of interest within easy reach, make this town a favourite resort for visitors.

Towns in the Hills.—Belair, 5 miles in a direct line from Adelaide (14 miles by rail), is on the foothills of the Mount Lofty Ranges. Immediately adjoining the railway station is the National Park (2,000 acres), secured to the people in perpetuity, and is much frequented. On the eastern side of Mount Lofty are the townships of **Crafers, Stirling,** (**East and West**), **Summertown, Uraidla,** and **Aldgate,** principally devoted to garden and orchard culture. This district is also the high-level residential locality for the city of Adelaide, and is studded with fine mansions and beautiful gardens. Further to the east, are **Balhannah, Woodside,** and **Charleston,** in the Onkaparinga Valley; **Mount Barker, Nairn,** and **Strathalbyn.**

In the Barossa Ranges are **Angaston, Tanunda, Nuriootpa,** and **Williamstown,** noted for their orchards, vineyards, and rich pastoral country. **Melrose,** picturesquely situated at the foot of Mount Remarkable, and **Wilmington,** are in the southern portions of the Flinders Ranges.

River Murray Towns.—Goolwa is the most southern port on the river, and is connected with Adelaide by rail. **Murray Bridge,** is on the Adelaide and Melbourne railway, where the line crosses the river by a fine bridge which is a quarter of a mile long. **Morgan,** situated at the North-West bend of the river, is the terminus of the Adelaide, Kapunda, and Morgan line of railway. It is an important port for the up-river trade. **Renmark** is the largest of the River Murray irrigation settlements in South Australia, and has a population of 3,000.

Seaside Resorts.—On St. Vincent Gulf, in the vicinity of Adelaide are **Brighton, Glenelg, Semaphore,** and **Henley Beach.** On the Southern Ocean are **Victor Harbour**, possessing a fine land-locked inlet of the sea, which is protected by Granite Island, and a jetty half-a-mile in length; **Port Elliot,** situated on a granite promontory has a bracing atmosphere; **Robe,** on a headland south of Guichen Bay, is noted for its salubrious and temperate climate; and **Port MacDonnell,** near Cape Northumberland, the most southerly town in South Australia.

CHAPTER X.—GOVERNMENT.

The Government of South Australia was, in the first instance, autocratic, the executive power being entrusted to a Governor who was the representative of the Sovereign and responsible only to the Imperial Government. The Governor, however, had no control over the disposal of the land or in matters pertaining to emigration, which, for a time, were under the direction of the Colonization Commissioners, who sat as a Board in London and acted through their local representative, James H. (afterwards Sir James) Fisher. This dualistic form of government led to friction and resulted in Governor Hindmarsh resigning after only fourteen months of office. To prevent further friction, Fisher was relieved of his duties as Resident Commissioner.

and Colonel Gawler, who succeeded Governor Hindmarsh (1838), received the double commission of Lieutenant-Governor and Resident Commissioner of Public Lands. By a new Act of the Imperial Government, an Executive Council was established to act in conjunction with the Governor in making the laws and levying taxes in the colony; the Council was to consist of not less than three persons, resident in the colony and chosen by the Sovereign in Council.

During the first fifteen years of its existence South Australia was practically a Crown Colony, governed by the Secretary of State in London, through the resident Governor assisted by a Council of eight members, half of whom were prominent officers in the Service and the remaining half the nominees of the Governor. During that time the people had no representation in the Government and no voice on the important questions of taxation and expenditure.

The Act of Parliament by which the Colony was founded stipulated that as soon as the population reached 50,000 persons a representative constitution would be granted. The census of 1851 showed the population to be 63,700, and steps were immediately taken to secure a measure of popular control in the administration, which was granted the same year by the Secretary of State for the Colonies (Earl Grey), during Sir Henry Young's term as Governor.

The constitution thus granted authorised the establishment of a **Legislative Council,** limited to twenty-four members, one-third to be nominated by the Governor and two-thirds by the people. The Council had control of the general revenue, but the

Governor, as representative of the Crown, controlled all revenue derived from the sale or leasing of the State lands. This system of Government, partly autocratic and partly popular did not work well, and was soon superseded.

In 1853 the Legislative Council passed a Constitution Bill providing for two legislative chambers, one elected by the people, and the other consisting of nominees of the Crown with tenures of office for life. This proposed new constitution provoked great popular discontent and agitation, and appeals against it were sent to London and resulted in the Secretary of State sending the Bill back to the Legislative Council for reconsideration. A dissolution of the Council followed for the purpose of securing a popular vote on the definite question before the country. The newly-elected Council determined that the Legislature should consist of two chambers: an Upper House, to form the **Legislative Council**, consisting of eighteen members, one-third of whom should retire every three years; and a Lower House, as the **House of Assembly**, consisting of thirty-six members, limited to a triennial period of election. The voting qualification for the Legislative Council was fixed at £50 freehold, or leasehold of an annual value of £20, or house-tenancy of £25 a year. The franchise for the House of Assembly was manhood suffrage after six months registration—election to both Houses to be by ballot. This Bill received the assent of the Crown without amendment. (1856).

The modification of the political position by the new constitution was very great. A very broad representation on democratic lines was assured.

The Governor was excluded from party politics, and, other than as a representative of the Crown, he was limited by the advice of his responsible ministers. No act of the Governor could have any force unless endorsed by the Ministry in power. Sir Richard MacDonnell was Governor of the Province when the new constitution came into force, and for some time mutual forbearance and tact were demanded from all parties concerned in the transference of the prerogatives of government.

The Constitution as determined in 1856 has remained, in its fundamental principles, unaltered to the present time. In 1873 the number of members of the House of Assembly was increased to forty-six, subsequently to fifty-two, and then to fifty-four; but when federation was accomplished (1901), the numbers were reduced to forty-two, the Legislative Council from 24 to 18, and the members of the Ministry from six to four, but in 1908 the latter were increased to six. In 1913 a change was again made, when the members of the House of Assembly were increased to 46, and those of the Legislative Council increased to 20. In 1907 a memorable struggle took place between the two branches of the Legislature on the question of lowering the qualification vote for the Legislative Council. A compromise was reached in the amended statute, that any person occupying premises for which he is paying not less than £17 per annum, or any registered proprietor of a Crown lease on which there are improvements to the value of £50, is entitled to be enrolled as an elector for the Council. As this brings the franchise qualification down to a rental of about 6s. 6d. per week it is almost equivalent to household suffrage.

Payment of members of Parliament (£200 a year each) was introduced in 1888, and in 1894 the franchise was granted to women on equal terms with men.

The States of Australia were federated as a **Commonwealth** of Australia, on January 1, 1901. The Commonwealth Government consists of two Houses: a **Federal Senate** in which all the States of Australia have an equal representation; and a **House of Representatives**, in which the different States are represented in proportion to their population. South Australia, in common with her sister States, has six members in the Senate, and at present, seven members in the House of Representatives. The Federal Government has power of control over the Customs, Post Office, Telegraphic, Meteorological and Immigration Departments, Naturalisation, and Defence; whilst taxation (other than customs and excise), the land, and local administration are in the hands of the individual States.* A Governor-General appointed by the Crown is the intermediary between the Commonwealth and the Imperial Government, but the State Governors communicate directly with the Colonial Office in London on local matters affecting the State. The Australian Customs Duties are strongly protective with a 5 per cent. preference allowed on British goods.

A leading policy of the Federal Government is to secure what is called a "**White Australia,**" and has found expression in the **Immigration Restriction Acts**

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* Of late years the Commonwealth Government has made further claims in the way of taxation, see page 293.

(1901-5). The object contemplated is to keep out "prohibited immigrants" and to people Australia with the European ("white") race. The Act excludes from admission to the Commonwealth (*a*) any person who fails to pass a dictation test in writing, of fifty words (the same to be in any language at the option of the investigating officer); (*b*) any person likely to become a charge on the State; (*c*) any idiot or insane person; (*d*) any suffering from an infectious or contagious disease of a loathsome or dangerous character; (*e*) a criminally convicted person who has not served his sentence or received a pardon. Certificates of exemption (for a specified time) may be given when an otherwise "prohibited" person visits the country for a specific and temporary object, or in the case of members of a ship's company in port, or where the person having been a resident in the Commonwealth for not less than five years goes out of the Commonwealth and returns again within a specified time; or by the payment of £100, subject to the approval of the officer.

In accordance with the same policy it was enacted that after March 31, 1904, no Pacific Islands labourer should be allowed to enter Australia, and those that were already here, indentured on the sugar plantations of Queensland, should be gradually deported to their homes. In 1901 it was also enacted that "no contract or arrangement for the carriage of mails shall be entered into on behalf of the Commonwealth unless it contains a condition that only white labour shall be employed in such carriage."

Public Debt.—The total net debt of South Australia on June 30th, 1915, amounted to £33,490,179.

The amount of indebtedness per head of the population at the date mentioned was £76 8s. 6d. This has been built up mainly by expenditure on reproductive works which are paying interest on their construction. The following Table shows how the public debt of South Australia has been incurred:—

	PER CENT.
Railways and Tramways	49.66
Telegraphs and Telephones ...	3.53
Water Supply and Sewerage ...	19.11
Harbours and Rivers	5.96
Roads and Bridges	5.22
Defence	1.04
Public Buildings	3.09
Advances to Settlers	0.32
Land Purchase for Settlement ...	2.98
Rabbit-Proof Fences	1.07
Other Public Works	8.02
	100.00

The following figures show the State Revenue from Public Works and Services in South Australia for the year ended June 30th, 1916:—

	£
Railways and Tramways ...	1,997,984
Harbour Services	107,836
Water Supply and Sewerage ...	193,542
Other Public Services	134,247
State Lands Revenues	268,955
Total	£2,702,564

The taxes imposed by the States are mainly those which concern income, probate and succession duties, stamp duties, land tax, etc. In the year ended June, 1916, these in South Australia produced a revenue of nearly £665,000. The total revenue in South Australia for the year mentioned was £4,356,967, and the total expenditure £4,741,376, showing a deficiency of £384,409.

Commonwealth Finances.—Under the Federal Constitution the Commonwealth Parliament has the exclusive power to impose customs and excise duties, and controls postal, telegraph and telephone services, patents and trade-marks, Northern Territory, coinage, etc. In the following items the Federal and State imposts are duplicated, viz., land tax, income tax, probate and succession duties. The Commonwealth revenue for the year ended June 30th, 1916, amounted to £30,627,943, and the disbursements, for the same period, amounted to nearly £59,000,000 In the latter were included old age and invalid pensions, £2,909,191; payments to 131,943 claimants for the Commonwealth maternity allowances (the amount being £5 in each case); and military forces, £43,736,655.

Australian Indebtedness.—On June 30th, 1916, the Commonwealth public debt amounted to £101,252,948; and the public debts of the several States collectively to £356,337,064; making a grand total of £457,590,012.

Defence.—Military service for purposes of defence is compulsory throughout the Commonwealth. The order of training is as follows:—**Junior Cadets** include boys from 12 to 14 years, who receive instruction of an elementary character, chiefly from their school teachers. **Senior Cadets** are registered at 14 years of age, and undergo 64 hours of training each year, divided up into whole-day, half-day, and night-drills, till they attain the age of 18. **Citizen Forces** consist of such as have passed through the Junior and Senior cadetship and are drafted into some section of the Commonwealth Defence Force, (similar to the Territorial Force of Great Britain), and are required to undergo 16 days of training in the year, 8 of which are spent in camp. Artillerymen and engineers are required to put in a somewhat longer period of drill. The annual training is continued until the trainee reaches the age of 26 years. Pay is allowed the citizen forces for attendance at parades. In addition to the above there are volunteer Rifle Clubs which, in the year ended June 30th, 1917, had a membership of 106,401.

Australians, fortunately, have never been called upon to defend their homes and country, but they have participated in the honour of defending the integrity of the Empire. In 1885, New South Wales sent a contingent of 770 men to serve under Lord Wolseley in the Suakin campaign; and in the Boer war (1899) a total of over 16,000 mounted troops was sent from Australia, in successive contingents, and proved valuable auxiliaries to the Imperial Forces. To commemorate this latter event a national memorial was erected by public subscription, in Adelaide, on which is inscribed the names of those South Australians who fell in the campaign. In the Boxer rising in China, naval volunteers from New South Wales and Victoria, to the number of about 500, were accepted by the Imperial authorities; and South Australia sent its gunboat, *Protector*, to the scene of hostilities, and the latter did useful service on the rivers of China at that time.

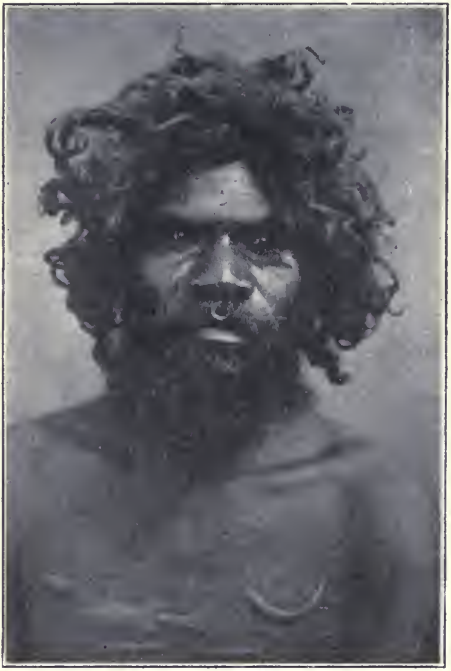
In the great world war, which, unfortunately, is still in progress while the present work is passing through the press, Australia has rendered important services in aid of the Allies' cause. A volunteer army of 300,000 men has been equipped, despatched, and maintained at fighting strength in this great struggle, and the honour of Australia has been worthily upheld by its citizen soldiers on the battlefields of Egypt, Gallipoli, Palestine, France, and Belgium.

CHAPTER XI.—THE ABORIGINES.

The question of the **origin** of the Australian aboriginal races has given rise to much difference of opinion. Just as the animals and plants of this island continent are largely peculiar to Australia, the same thing may be said of its aboriginal population; they cannot consistently be included in any of the other great ethnological divisions of the human race. Some anthropologists consider that they originated from a cross between the Papuan and the Malayo-Polynesian races; others see a resemblance between the Australian aborigines and the Pre-Aryans of India; some think they detect characteristics indicating a Caucasian origin; whilst others, again, regard the Australian aborigine as a survival of one of the early types of primitive man. The homogeneity of the Australian race, as well as their differentiation from other branches of the human family, indicate a remote origin; but this has not been, up to the present, confirmed by any geological evidence of a high antiquity in their occupation of the country.

The physique of the Australian aborigines differs to some extent under the wide range of conditions in so vast a country. Where food is plentiful, the physical development is good and compares favourably with that of an average European, but in the drier parts of the continent, with harder conditions of life, the aborigines are of a poorer type possessing thin limbs of abnormal length. In their general characteristics the skull is long (dolicocephalic), very thick, especially in the frontal portions, and usually with retreating forehead. The nose is very squat and expanded at the nostrils. The hair is straight or curly, but never woolly like the negro, or the extinct Tasmanians who belonged to a different race. The men have thick beards, and often a considerable growth of hair covers the body. The colour of the skin is usually a dark chocolate brown, but the shade varies considerably in different individuals. The foot is not arched, as in the foot of the European, but has nearly a flat sole, and the toes are relatively more mobile enabling their owner to grip objects and to climb trees with great dexterity. The physical senses, such as sight and hearing, have become highly developed by their mode of life and are very keen. It is a common practice for both men and women to ornament their bodies by tattoo markings and raised scars, as seen in the accompanying figures. (Figs. 75 and 76.)

Social Characteristics.—The national sentiment has been but feebly developed in the Australian aborigines, and as a consequence there is little cohesion in the numerous tribal units into which they have become divided. Each tribe is a social entity, possessing certain territorial rights, and one tribe cannot trespass on the domains of another without certain recognised formalities. A tribe, however, is often a segregation of minor divisions which may have been offshoots from a common stock, possessing certain similarities of language and interests in common. These sub-sections are often in conflict with each other, but they readily combine against a common foe. For matrimonial and other ceremonial purposes the tribe is divided up into classes of a very rigid kind, and each of these classes is distinguished by a symbol or "totem," taken from some animal, plant, or other natural object, one class being, say, under the snake

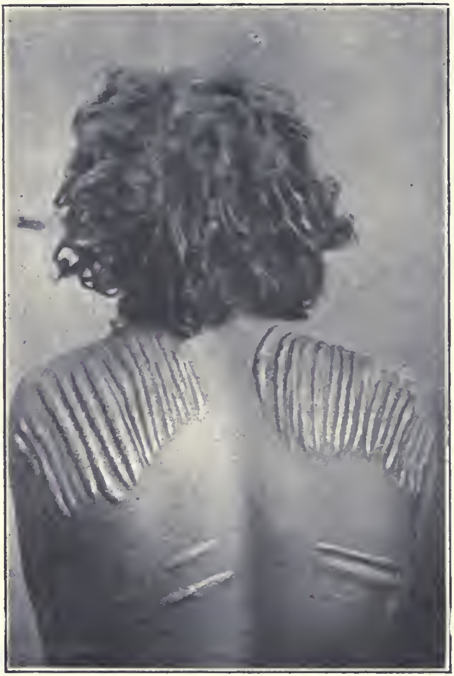


W. T. Lingwood Smith

Fig. 75. An Aborigine of the Fowler's Bay Tribe.

"totem," and another the emu "totem," etc. No man or woman is allowed to marry into his or her own class or totem, but the suitor must take his wife from a section having a different "totem" from his own, a social law which has probably arisen from a knowledge of the evils of consanguinity learnt from experience. Infanticide is (or was) common, especially in the case of female children, and arises from the inconveniences attendant on raising too large a family in a nomadic life. At the same time, the parents generally show great attachment to their children and are very ready to indulge them. The government of the tribe is in the hands of the old men, and occasionally some one of these by force of character comes to the front and is the chief of the tribe in matters of deliberation. The women are entirely under subjection to the men and a wife is the absolute property of her husband for whom she must work, and by whom she is often cruelly treated. Cannibalism was formerly practised by some tribes, and in certain cases took the form of eating the murdered babies. This was done by the parents or intimate friends of the family under the notion that they showed thereby their affection for the slaughtered child.

Food.—The Australian aborigine is not at all particular (except under ceremonial restrictions) as to his diet, either as to its kind or condition, eating with a peculiar relish animal food which is in a high state of putrefaction. Most animals are eaten, including lizards, snakes, frogs, tadpoles, locusts, grubs, white ants, and other insects. They are skilful in catching fish by spearing and in nets. Honey is a great delicacy and they discover the nests of bees by tracking the bees in their flight. While the men hunt big game it is the women's duty to collect vegetable foods, such as berries, roots, herbs, and seeds. Hard seeds are ground between two stones with water into a kind of paste, which is eaten raw or baked. It is also the women's duty to search for shellfish at low tide, along the rocky seashore. Young men are often placed under restrictions with respect to eating certain kinds



W. T. Lingwood Smith

Fig. 76. The same aborigine as shewn in Fig. 75. His back is ornamented by numerous cicatrices or scars.

of food, easily obtained, which they are led to believe would bring injury upon them.

Clothing to the uncivilised aborigine is of small moment, and in most tribes is not adopted at all. Their arts in this direction have not gone beyond the preparation of skins, which can be used as mats or as a covering at night, but become a source of encumbrance by day. In the colder portions of Australia, a cape, made from opossum skins, is sometimes worn over the left shoulder and tied under the right arm, leaving the latter free for action. A waist cord, usually made from opossum fur or human hair, is found convenient for carrying objects, such as a hafted tool; a few tassels, forming a small apron in front; and ornamental bands around the arms, neck or head, generally complete the toilet. For special occasions, such as dances and corrobborees, a more elaborate ornamentation, with feathers, kangaroo teeth, and daubs of red (ochre) and white (kaolin) paint, is adopted. The flesh on the breast and back is often cut with sharp shells or stones and the process is repeated till thick cicatrices, or scars, occur in a succession of lines, which are considered to improve the personal appearance of the individual. See Figs. 75 and 76.

Implements and Weapons.—Prehistoric man in all parts of the world has had the same simple wants, and has used precisely the same kinds of tools to supply his needs, varying only in the finish of the implements, according to the respective intelligence of the workers. The palæolithic men made only a few rude implements, roughly chipped and never polished. The later, neolithic men, had a greater variety of tools which were better finished, and they carefully shaped their axes by grinding and polishing. The aborigines of Australia, in their native condition, have a relatively small number of stone implements—perhaps intermediate in this respect between the palæolithic and advanced neolithic races—and they grind and polish the edge only of their axes. Their implements in stone are chipped from cores which possess a conchoidal fracture, such as flint, chalcedony, jasper, hornstone, quartz, and quartzite. From these rocks they manufacture a variety of tools and weapons, such as knives (sometimes hafted); chisels and gouges, generally attached to a stick or the end of a womerah (throwing stick); scrapers of various shapes, for cleaning and softening skins, shaping wood implements, spears, etc.; pointed chips of quartz, for carving designs on wooden implements or making incisions in the flesh; stone axes, which are mostly made from an igneous dyke-rock (greenstone), on account of its hardness and toughness; and pounding and grinding stones, selected for their hardness and roundness, used for breaking down seeds, etc. In northern Australia, stone spear-heads are commonly used, but these are not in use among the tribes further south than Tennant's Creek. Implements and weapons made of wood consist mainly of the following:—An excavated wooden vessel for carrying water; canoes, made by cutting out large sheets of bark from the red-gum; wooden pointed sticks, for digging up roots; barbed spears for spearing fish. Their chief weapons include a club or waddy, boomerangs of various sizes and shapes, spears pointed with hard wood, sometimes strongly barbed with either wood, kangaroo teeth or pieces of quartz;

shields, etc. Twine is an essential article for making the waist-cord, constructing fishing and other kinds of nets, sewing opossum skins together, etc., and is made from fur, human hair, sinews of the emu, or vegetable fibre, the last named being chewed and twisted in the process of manufacture. A needle of bone is used to perforate the skins when sewing them together. The aborigines are also very clever in making mats and baskets from rushes that grow along the banks of the River Murray.

Ceremonies and Pastimes.—Ceremonial observances are connected with almost every aspect of individual and tribal life. The various stages of development in the birth and growth of a child, initiation into manhood, and the communication to the novice of tribal secrets and privileges, are attended by fixed, elaborate and often painful rites, of which the origin and purpose are unknown. A profound belief in witchcraft colours much of their crude philosophy of life. Diseases, death, and all the ills of life, are attributed to evil disposed persons who possess magic arts, and by such means secretly injure their victims. Magic must be counteracted by magic, and thus the witch-doctor carries much influence in his tribe. A chronic state of intertribal suspicion is thereby fostered, and many of the intertribal conflicts arise from one tribe seeking reparation from another for suspected evil influences they have exerted on certain members of the tribe who have fallen ill or died. Incantations and ceremonials are constantly practised to avert droughts and bring rain, to secure abundant game, obtain a favourable issue to some enterprise, or appease the spirits of the departed. Amidst it all, the aborigine in his primeval surroundings is a true child of nature, merry, good-natured, generous, and ready to take out of life all the pleasure he can get. He enjoys intercourse with other branches of his race, enters with enthusiasm into the traditional games and dances and forgets all weariness in the rude, but often clever acting which is produced in the corrobboree—the black man's theatre.

Mental Development and Language.—The Australian is by nature a hunter—a nomad—he must follow the game. When food becomes scarce in one place he must remove to another. These conditions have powerfully reacted on the race in retarding mental development and the introduction of the higher arts. He has no architecture, although ample materials are at hand for making permanent structures. A "wurly," constructed of a few branches to provide a shelter from the wind, answers all his purpose as a temporary camp—he has no permanent dwelling. It has never entered his mind to improve the conditions of life by cultivating useful plants, or rearing animals for food. The only domesticated animal he possesses is the dog. Clay has been in constant use for decoration of the person, but he has not discovered the use of pottery. He has made a kind of twine but has not learnt the art of weaving beyond simple, hand-made bags and nets. He has no providence in husbanding resources against future needs—he will gorge himself to-day oblivious of the requirements of to-morrow. Fire is caused by the friction of a stick, rapidly rotated between the two hands with the point inserted in a soft tinder-like piece of wood.

The language of the aborigines in different parts of the continent varies greatly. Some are manifestly dialects coming from a common stock, whilst others are so distinct as scarcely to have two words in common; but even in such languages there is a family likeness in the euphony and grammatical construction characteristic of each. The native speech, though necessarily limited in its vocabulary, is peculiarly rich in certain classes of words, such for example, as indicate conjugal, family, and ancestral relationships, or those expressive of their daily needs and sensuous pleasures. There are no terms in their language which indicate definite numbers higher than three, but these may be compounded by saying two and two (meaning four), or by means of the fingers and toes they can represent numbers up to twenty; all above which are expressed by the indefinite word "many."

The primitive condition of the people is illustrated in that the languages are almost destitute of words of an abstract nature. They have not learnt to generalize in their thinking, or to form mental ideals—they have neither philosophy nor poetry. The traditions and folklore of the tribes seem to have arisen from a weird imagination, rather than as nature myths with symbolical meanings, as has occurred with early peoples of a higher standard of culture. The religious sentiment appears in this people in its most primitive form. A kind of animistic belief prevails, in which the spirits of their ancestors are represented in the respective totems of the tribe and are reincarnated in each member of any particular totemic group. In this way there is a sacred bond between each person and the totem of his ancestral line. They have a lively fear of spirits—the ghosts of the dead—which are supposed to be generally bent on mischief, and for this reason the aborigines have a special dislike of travelling in the dark. There is no written language, but tribes and individuals communicate with each other by a variety of smoke signals, and also by message sticks, on which are engraved certain recognised lines and symbols by which information is communicated. The art of the Australian aborigines is confined to simple patterns on their wooden implements, rude rock drawings of animals, etc., and totemic designs which are often not wanting in artistic features.

Tribes of the Southern Coast.—George Taplin, who for many years was the Superintendent of the Point Macleay Aborigines Mission Station, says that the Lower Murray and coast line between Kingston and Cape Jervis was inhabited by a confederacy of eighteen tribes, calling themselves the **Narrinyeri,** speaking the same language and observing the same customs, often engaged in petty conflicts between themselves but rallying with a united front when threatened by a common enemy. This was the most important group of tribes in southern Australia. They flattered themselves on their superiority to the surrounding tribes and those occupying the Adelaide Plains. They had a special dislike to the **Merkani,** or Tatiara blacks, who were cannibals and stole the fat women of their neighbours as a special delicacy. The **Wakanuwan** or Adelaide tribe, was much less influential than the Narrinyeri, both in numbers and martial spirit. George Taplin narrates that in 1849 he witnessed a battle in which 500 of the Narrinyeri met 800 of the Adelaide tribe, and would have routed the latter had not the colonial authorities stopped the fighting. It was the Narrinyeri who treacherously murdered Captain Barker and also the crew and passengers of the ship, *Maria*.

Population and Government Assistance.—When Europeans first visited Australia, the aboriginal population probably numbered about 150,000, and is now principally limited to the north and north-central regions. In the settled portions of Australia, there are only a few scattered remnants left, some of which are gathered into Mission Stations; or, a few families together, become attached to inland sheep and cattle stations; or wander between a few recognised camps on the lower Murray and places on the coasts where fish is plentiful. The introduction of diseases by contact with the whites, such as measles, whooping-cough, phthisis, etc., has reduced their ranks, and the cutting off their food supplies by European settlement, has still further lessened their numbers. They make excellent station hands, and by their extraordinary powers of "tracking" are of signal service to the Police Department.

There is a "Protector of Aborigines" Department in the Government service, established in the interests of the aboriginal population. Blankets and rations are distributed at regular intervals from about 40 depôts in various parts of the State. Prior to the transfer of the Northern Territory to the Federal Government there were five Aborigines' Mission Stations in South Australia, but these are now reduced to three. Originally they were all controlled by religious bodies, on an industrial, educational, and religious basis. Two of these, namely, Point Pierce, on Yorke Peninsula, and Port McLeay, on Lake Alexandrina, have recently been taken over by the South Australian Government. Point Pierce Station, which possesses 17,298 acres of land and 189 natives and half-castes, is self-supporting; but Port McLeay Station, with only 5,514 acres and 380 natives and half-castes, is dependent, in part, on Government assistance. Koonibba, the third Aborigines Station, is situated at Denial Bay, on the West Coast, and is under the control of the Lutheran Church. The natives under instruction are quick to learn, the school results are excellent, and the religious services are supported with trained choirs and musical instruments entirely in the hands of the aborigines. The Parliamentary vote in South Australia for the Department, in 1916, was £19,139. On the 30th June, 1912, the estimated aboriginal population of South Australia was, Blacks, 4,000; half-castes, 836. For the same year the births numbered 55, and the deaths 70.

REFERENCES.

The Native Tribes of South Australia, comprising The Narrinyeri, by Rev. Geo. Taplin; The Adelaide Tribe, by Dr. Wyatt; The Encounter Bay Tribe, by Rev. A. Meyer; The Port Lincoln Tribe, by Rev. C. W. Schurmann; The Dieyerie Tribe, by S. Gason, and Vocabulary by J. W. O. Bennett. Adelaide, 1879. Spencer and Gillen—Native Tribes of Central Australia. London, 1899. Also, by same authors, Northern Tribes of Central Australia, London, 1904. Thomas, N. W.—Natives of Australia, London, 1906.

APPENDIX.

TABLE OF STRATIFIED ROCKS OF SOUTH AUSTRALIA.

I. Kainozoic.—The animals and plants of this Division, as compared with the older, show an increasing likeness to those of existing forms. True birds and mammals are characteristic types, and at the close, man appears.

Recent.

1. **Raised sea-beaches and sand-dunes** of the Gulfs and the South-east.
2. **Marine and estuarine limestones** of the raised coastal plains, east of the Coorong and in the South-East.
3. **Volcanic tuffs and lava outflows** of Mount Gambier, Mount Schank and Mount Burr.

Life—Same as at present, but some forms have become locally extinct.

Pleistocene.

1. **Freshwater Beds.**—Old river valleys with river terraces and lacustrine deposits, in positions not always conformable to the present river systems. Gold drifts of Barossa and other places. **Life.**—Bones of large extinct marsupials, (*Diprotodon*. etc.), and struthious birds (*Genyornis*, etc.), in the alluvium of streams and lakes at Adelaide, Gawler, Callabonna, etc.

   Mottled clays and sands of Hallett's Cove, Ardrossan, etc., which, in places, pass under the waters of the Gulf.

Upper Pliocene.

2. **Newer Marine.**—Proved in bores at Dry Creek, and Croydon at 320 feet from the surface. About 20 per cent. of the mollusca are living forms.

Lower Pliocene (Tate's Miocene).

3. **Middle Marine.**—Oyster beds and slightly indurated sandstones with casts of shells, forming the upper beds of the River Murray valley and sea cliffs of the Gulf St. Vincent, also the crystalline limestone on top of cliffs at the head of the Great Bight. **Life.**—Shallow-water mollusca including about 10 per cent. of living forms.

Miocene (Tate's Eocene).

4. **Older Marine.**—Thick limestones and calcareous sandstones of the River Murray valley and coastal districts—sometimes covered by more recent deposits. **Life.**—Mollusca and other marine invertebrates, mostly preserved in the form of casts. Bones of whales, fish, sharks' teeth, etc. Only a few forms belong to living species.
5. **Lower Freshwater Beds.**—Lacustrine sands and clays with carbonaceous matter and lignite—sometimes interstratified with marine deposits. Kent Town Bore, Murray Flats, Ninety-Mile Desert, Nullarbor Plains.

II. **Mesozoic.**—(Middle or intermediate life.)—Animals show an advance on those of the Palæozoic Division, but are of more generalized (or primitive) types than those which came later. Large reptiles of many and peculiar forms were very characteristic of this Division. The lower forms of mammalia (marsupials) and reptile-like birds appear. Many of the shell-fish were of striking forms and peculiar to this period. The plants were mostly conifers (pine family), ferns, and cycads, the latter a form of vegetation which combines the features of both ferns and palms.

1. **Upper Cretaceous.**—Desert sandstone, siliceous clays, white clays, and marls, with chalcedony, opal, and jaspery rocks, forming the table-top hills and stony deserts of Central Australia. Mostly freshwater beds.

2. **Lower Cretaceous.**—Shales, sandstones, mudstones, marls, and argillaceous limestones, forming the artesian water basin of Central Australia. **Life.**—Marine mollusca (Belemnites, etc.), large reptiles, (*Plesiosaurus*), silicified and calcified wood.

3. **Jurassic.**—Shales, carbonaceous shales, brown coals, sandstones, and ironstones. Leigh's Creek Coal Field. **Life.**—Fresh-water mollusca (*Unio*) and ferns.

   The **Triassic** System is not known in South Australia.

III. **Palæozoic.**—(Ancient life.) The animal types are mostly peculiar to this Division, and very unlike those of the later periods. Vertebrates (fish and reptiles) make their first appearance in the upper parts of this Division. The plants were mostly ferns and club-mosses.

1. **Permo-Carboniferous.**—At the time when the Sydney Basin was sinking and receiving the thick deposits of coal, South Australia was highland and covered in many places by permanent snow and ice. The morainic deposits from this land-ice covered thousands of square miles of the southern portions of South Australia at this period. Glacial clay and ice-scratched boulders are found in the Inman and Hindmarsh Valleys, at Myponga, Cape Jervis, Kangaroo Island, and Yorke Peninsula, and extend as far north as Hallett's Cove.

   (No rocks of **Devonian** or **Silurian** age are known in South Australia.)

2. **Ordovician.**—Sandstones, quartzites, and red limestones forming the southern elevations of the MacDonnell Ranges. Richly fossiliferous near Tempe Downs Station.

3. **Cambrian.**—Forms the south-central highlands of the State.

   Upper.—Purple slates, quartzites, and limestones of the Flinders Ranges. Coral reefs of an ancient and extinct type, (Archæocyathinæ), more than a hundred feet in thickness, occur in the Flinders Ranges, on Yorke Peninsula, and at Sellick's Hill.

Lower.—Slates, quartzites, phyllites, and limestones of the Mount Lofty Ranges. The Brighton limestone is near the top. Glacial-till beds (with ice-marked erratics) in great thickness, on the Onkaparinga, the Sturt, Petersburg, etc. Basal grits and conglomerates at Inman Valley, Aldgate, Barossa, etc.

IV. **Pre-Cambrian—Archæan.** The lowest division of recognised sedimentary rocks. Rocks greatly altered and crystalline. All evidences of life destroyed.

Slates, schists, altered quartzites, and gneissic rocks, penetrated by granite and pegmatite dykes, forming an intricate complex. These occur as inliers (exposed by denudation) along the Cambrian axis of elevation in the central ranges, at Aldgate, Hindmarsh Tiers, Humbug Scrub, etc. They underlie beds of Upper Cambrian age at Ardrossan, Y.P. The igneous and metamorphic plateaus of Eyre Peninsula are probably of this age.

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